

# Other Area 9 Interim Measure – Third Semiannual Report

**Boeing Plant 2  
Seattle/Tukwila, Washington**

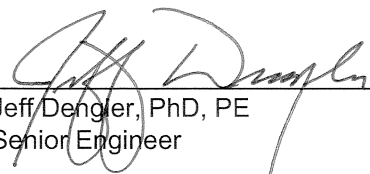
Prepared For:


**The Boeing Company  
P.O. Box 3707  
M/C 1W-12  
Seattle/Tukwila, WA 98124**

July 29, 2010

Prepared By:

Environmental Partners, Inc.  
295 N.E. Gilman Blvd., Suite 201  
Issaquah, Washington 98027  
(425) 395-0010

  
\_\_\_\_\_  
Jeff Dengler, PhD, PE  
Senior Engineer

  
\_\_\_\_\_  
Douglas Kunkel, LHG  
Principal Hydrogeologist

Project Number: 17512.0.6

QR  TR 

## TABLE OF CONTENTS

<b>1.0 INTRODUCTION .....</b>	<b>1</b>
<b>2.0 INTERIM MEASURE IMPLEMENTATION .....</b>	<b>2</b>
<b>3.0 PERFORMANCE MONITORING METHODOLOGY .....</b>	<b>3</b>
3.1 Respirometry Test Methodology .....	3
3.2 Groundwater Sampling Methodology .....	3
<b>4.0 PERFORMANCE MONITORING RESULTS.....</b>	<b>5</b>
4.1 Fifth Quarter .....	5
4.2 Sixth Quarter .....	5
4.3 Data Summary .....	6
<b>5.0 CONCLUSIONS .....</b>	<b>8</b>
<b>6.0 SCHEDULE .....</b>	<b>9</b>
<b>7.0 REFERENCES .....</b>	<b>10</b>

## TABLES

Table 1 – OA-9 IM Respirometry Test Results

Table 2 – OA-9 IM 5th Quarter Groundwater Analytical Data Summary (January 2010)

Table 3 – OA-9 IM 6th Quarter Groundwater Analytical Data Summary (April 2010)

Table 4 – OA-9 IM Groundwater Monitoring Analytical and Field Parameter Data Summary

## FIGURES

Figure 1 – General Location – Boeing Plant 2

Figure 2 – General Location of the OA-9 Interim Measure

Figure 3 – OA-9 IM Approximate Extent of Soil Contamination

Figure 4 – OA-9 IM Approximate Extent of Benzene Impacts in Groundwater

Figure 5 – OA-9 IM Groundwater Impacts, EAD Injection Locations, and Bioventing System

## ATTACHMENTS

Attachment A – Respirometry Test Data and Oxygen Curves

Attachment B – Groundwater VOC Analytical Data – All Detections

Attachment C – Field Parameter Data

Attachment D – Field Notes

Attachment E – Data Validation Reports

## ACRONYMS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
COC	contaminant of concern
°C	degrees Celsius
DPT	direct-push technology
dTMCL	draft Target Media Cleanup Level
EPA	United States Environmental Protection Agency
EPI	Environmental Partners, Inc.
EAD	enhanced aerobic degradation
IM	Interim Measure
mg/L	milligrams per liter
mV	millivolts
mS/cm	milliSiemens per centimeter
µg/L	micrograms per liter
NTU	nephelometric turbidity units
OA	Other Area
ORP	oxidation-reduction potential
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SCFH	standard cubic feet per hour
SL	Plant 2 Screening Level
SWMU	Solid Waste Management Unit
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons – diesel range
TPH-G	total petroleum hydrocarbons – gasoline range
UST	underground storage tank
VOC	volatile organic compound

## 1.0 INTRODUCTION

This third semiannual report presents information and data on the Interim Measure (IM) at Other Area 9 (OA-9) located in the 2-60s Area at Boeing Plant 2. This report covers data generated during the time period from November 2009 through April 2010. This report is the last semiannual report associated with the OA-9 IM. The OA-9 IM will be shut down in June 2010 and monitoring and bioventing wells associated with the OA-9 IM will be decommissioned as a necessary preparation step for building demolition work that Boeing has planned for this area. No additional quarterly analytical data will be generated following the April 2010 sampling event.

In a letter dated August 18, 2008 from the United States Environmental Protection Agency Region X (EPA) to Boeing, EPA gave approval to implement the *Interim Measure Work Plan for Other Area 9* (Environmental Partners, Inc. [EPI], 2008). This work plan presented details for remediation of total petroleum hydrocarbon (TPH) impacts to soil and groundwater in an area associated with Resource Conservation and Recovery Act (RCRA) Unit OA-9 and Solid Waste Management Unit 2-78.6 (SWMU 2-78.6). OA-9 consists of three former underground storage tanks (USTs) identified as PL-16, PL-17, and PL-18. SWMU 2-78.6 is a nearby former oil-water separator. When the three USTs and oil-water separator were removed from the OA-9 IM area, some contaminated soil was inaccessible and left in place due to numerous subsurface utilities. As a result, impacted soil occurs in discrete areas next to and within utility corridors, which makes the subsurface distribution of contaminant sources at OA-9 very heterogeneous.

The impacted vadose soil and groundwater associated with these units are being addressed together and are referred to as OA-9. Figure 1 presents a general location map of Plant 2 and Figure 2 is a site representation showing the location of the OA-9 IM at Plant 2.

Based on the *2-60s Area Data Gap Investigation Report* (EPI, 2006), contaminants of concern (COCs) for vadose zone soil at OA-9 are gasoline-range petroleum hydrocarbons (TPH-G) and the volatile organic compounds (VOCs) benzene and ethylbenzene. Groundwater COCs are TPH-G and the VOC benzene. Detailed drawings showing the locations of the soil detections and groundwater plumes are presented in the OA-9 IM Work Plan (EPI, 2008). Figures 3 and 4 present diagrams of the approximate extent of impacted soil and groundwater, respectively, at OA-9. The area of impacted groundwater shown in Figure 4 is defined by the benzene plume, which coincides with and extends beyond the TPH-G plume.

## 2.0 INTERIM MEASURE IMPLEMENTATION

Bioventing was selected as the IM soil treatment technology for vadose soil and enhanced aerobic degradation (EAD) was selected as the IM groundwater treatment technology. These two technologies complement each other and were implemented together at OA-9 to introduce oxygen into the subsurface soil and groundwater. The increased available oxygen is intended to enhance aerobic bacteria populations, which destroy contaminant hydrocarbons and VOCs through aerobic metabolism of the organic contaminant molecules.

Bioventing is an *in situ* soil remedial technology that introduces oxygen in air into the open pore spaces of vadose zone soil by using a blower to inject air at relatively low flow rates into the soil through a series of injection wells. The oxygen introduced into the soil stimulates indigenous microorganisms to metabolize and destroy organic compounds adsorbed to soil particles.

EAD is an *in situ* groundwater remedial technology that introduces chemically bound oxygen into groundwater, which stimulates the growth of indigenous microorganisms. The enhanced microbial populations metabolize and destroy petroleum hydrocarbons and benzene in groundwater. The oxygen-release compound used at OA-9 is a proprietary product with the trade name EHC-O™, which is produced by Adventus Americas, Inc. More detailed descriptions of these remedial technologies and their applicability and limitations are presented in the OA-9 IM Work Plan (EPI, 2008).

Prior to this IM remedial work at OA-9 included excavation and removal of contaminated vadose zone soil; however, buildings and extensive subsurface utilities in the area prevented the removal of all contaminated soil. Bioventing was implemented to remediate these remaining pockets of impacted vadose soil and augment parallel work to remediate the associated groundwater plume.

In September 2008 six bioventing wells were installed to facilitate in-situ remediation of impacted vadose zone soil. During October and November, pipe trenches were dug and 2-inch diameter PVC pipe was installed to provide a supply of pressurized air to all nine bioventing wells. A blower, trailer, pipe manifold, and electrical power were then installed and connected to supply air to the bioventing wells. Details of the wells and bioventing system installation are presented in the First Semiannual Report (EPI, 2009). The bioventing system blower was started on December 15, 2008. Respirometry testing was performed quarterly to monitor the status of the bioventing system.

During October and November 2008, a solution of 5,000 pounds of EHC-O™ and potable water was injected into groundwater in a grid of 20 points by direct-push technology (DPT). The injections were made over the depth interval from 10 to 30 feet below ground surface (bgs). Details of the injection process are presented in the First Semiannual Report (EPI, 2009). Groundwater was monitored quarterly to assess the progress of groundwater remediation. Figure 5 is a general representation of the bioventing system and EAD injection locations at OA-9.

### **3.0 PERFORMANCE MONITORING METHODOLOGY**

The primary objective of the OA-9 IM is to destroy TPH and the non-chlorinated VOC mass in vadose zone soil and groundwater through EAD. Performance monitoring was performed quarterly to evaluate remedial treatment progress. Performance monitoring data are compared to baseline data and previous performance monitoring data to determine reductions in contaminant concentrations and trends in subsurface geochemical conditions. There are two components of performance monitoring for the OA-9 IM: respirometry testing for vadose zone soil remediation and groundwater sampling for groundwater remediation. Procedures for both monitoring components are described below.

#### **3.1 Respirometry Test Methodology**

Respirometry testing is not a direct measure of soil remediation, but it does indicate the rate at which microorganisms are consuming available oxygen in the soil pore spaces. Results of respirometry testing provide an indirect measure of the rate of contaminant degradation by microorganisms. Respirometry testing was performed quarterly in coordination with groundwater performance monitoring.

Respirometry testing consists of turning off the bioventing blower, collecting pore space air samples from selected wells, and measuring the subsequent decline in oxygen concentration as microorganisms consume oxygen. Respirometry test wells were selected based on historical analytical data indicating that they are installed in areas with high concentrations of petroleum hydrocarbons.

Pore space vapor samples are collected from test wells approximately 1, 2, 3, 4, 6, and 8 hours after the blower is turned off. A high-volume air sampling pump is used to evacuate atmospheric air in the well casing, followed by pore space gas sample collection. Samples are collected into 5-liter Tedlar™ bags and measured for oxygen content using a QRAe multi-parameter gas meter. The oxygen concentration versus time for each tested well is plotted to produce an oxygen-decline curve that can be mathematically converted to a rate of petroleum degradation using standard bioventing assumptions.

#### **3.2 Groundwater Sampling Methodology**

Groundwater samples were collected quarterly from the six A-level monitoring wells at the OA-9 IM monitoring network. The six sampled wells are listed below and their locations are shown in Figure 5.

- |            |             |
|------------|-------------|
| • PL2-310A | • PL2-604A  |
| • PL2-311A | • PL2-605AR |
| • PL2-332A | • PL2-606A  |

Groundwater samples were collected using the methods and procedures presented in the Sampling and Analysis Plan (SAP), which is Appendix A of the OA-9 IM Work Plan (EPI, 2008).

Groundwater samples were analyzed for gasoline-range petroleum hydrocarbons by Method NWTPH-Gx; diesel- and heavier-range petroleum hydrocarbons by Method NWTPH-Dx; and benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds by EPA Method 8260C. Tables in the SAP present specifications for reporting limits, containers, preservation, and holding times.

## **4.0 PERFORMANCE MONITORING RESULTS**

### **4.1 Fifth Quarter**

Fifth quarter respirometry testing was performed on January 15, 2010. Respirometry test results are presented in Table 1 and test data and plots are presented in Attachment A. The fifth quarter respirometry test was performed using wells PL2-311A, PL2-604A, and PL2-606A. Estimated oxygen consumption rates were too low to calculate for PL2-311A, PL2-604A, and PL2-606A indicating no or minimal bioactivity at all three test wells.

Groundwater monitoring was performed on January 28, 2010. Groundwater performance monitoring analytical results are presented in Table 2 and Attachment B. Field parameter stabilization data measured during well purging prior to sample collection are presented in Attachment C.

Groundwater analytical results for the fifth quarter indicated detections of TPH-G at concentrations greater than the Plant 2 Screening Level (SL) of 800 micrograms per liter ( $\mu\text{g/L}$ ) in samples from PL2-310A, PL2-311A and PL2-604A. TPH-G was detected in the sample from PL2-605AR at a concentration less than the SL and was not detected in samples from PL2-332A and PL2-606A.

TPH-D was detected in the sample from PL2-310A at a concentration of 300  $\mu\text{g/L}$ , which is less than its SL of 500  $\mu\text{g/L}$ . Results for samples from all other wells were non-detect for TPH-D. Data from all wells were non-detect for oil-range petroleum hydrocarbons.

Benzene was detected in groundwater samples from three wells: PL2-310A, PL2-311A, and PL2-605AR, but only the sample from well PL2-311A was at a concentration greater than its SL of 4.48  $\mu\text{g/L}$  and draft Target Media Cleanup Level (dTMCL) of 2.0  $\mu\text{g/L}$ . The sample from well PL2-310A had a benzene concentration greater than the dTMCL but below the SL. Benzene was not detected in the samples from wells PL2-332A, PL2-604A, and PL2-606A.

All ethylbenzene sample results were at concentrations below the SL of 2,100  $\mu\text{g/L}$ . Samples from PL2-310A and PL2-311A (and its duplicate) had ethylbenzene concentrations greater than the dTMCL of 30  $\mu\text{g/L}$ . The remaining detections of BTEX constituents were at concentrations less than their respective SLs and dTMCLs. All VOC results for the fifth quarterly sampling event are presented in Attachment B.

### **4.2 Sixth Quarter**

Sixth quarter respirometry test was performed on April 13, 2010. Respirometry test results are summarized in Table 1 and test data and plots are presented in Attachment A. The sixth quarter respirometry test was performed using wells PL2-311A, PL2-604A, and PL2-606A. Estimated oxygen consumption rates of 0.09, 0.00, and 0.00 percent per hour were calculated for PL2-



311A, PL2-604A, and PL2-606A, respectively. The oxygen consumption rates indicate minimal vadose zone microbial activity at PL2-311A and no measurable vadose zone microbial activity at PL2-606A and PL2-604A.

Groundwater monitoring was performed on April 27 and 29, 2010. Groundwater performance analytical results are presented in Table 3 and Attachment B. Field parameter stabilization data measured during well purging prior to sampling are presented in Attachment C.

Groundwater analytical results for the sixth quarter indicated detections of TPH-G at concentrations greater than the Plant 2 SL of 800 µg/L in samples from PL2-310A and PL2-311A. TPH-G was not detected in samples from PL2-332A, PL2-604A, PL2-605AR, and PL2-606A.

TPH-D was not detected in the groundwater samples from any of the six OA-9 IM performance monitoring wells. Data from all wells were also non-detect for oil-range petroleum hydrocarbons.

Benzene was detected in groundwater samples from wells PL2-310A and PL2-311A at concentrations greater than its SL and dTMCL. Benzene was not detected in samples from other OA-9 IM wells.

All ethylbenzene sample results were at concentrations less than the applicable SL of 2,100 µg/L. Samples from PL2-310A and PL2-311A (and its duplicate) had ethylbenzene concentrations greater than the applicable dTMCL of 30 µg/L. The remaining detections of BTEX constituents were at concentrations less than their respective SLs and dTMCLs. All VOC results for the sixth quarterly sampling event are presented in Attachment B.

#### **4.3 Data Summary**

Table 4 presents TPH, BTEX, and field parameter data for baseline and all six quarters of groundwater performance monitoring. TPH-G and benzene concentrations are greater than Plant 2 SLs and dTMCLs in samples from PL2-310A and PL2-311A, but are generally trending downward in the fifth and sixth quarter sample data. Sixth quarter TPH-G data at PL2-311A and fifth and sixth quarter benzene data at PL2-311A and sixth quarter benzene data at PL2-310A indicated small increases in concentrations, which may be simple data variability. As of the sixth quarter TPH-D concentrations have decreased to non-detect in all wells. Contaminants have not been detected in samples from downgradient well PL2-332A demonstrating that the EHC-O™ injection associated with the OA-9 IM has not caused downgradient impacts.

Benzene concentrations have decreased to non-detect in samples from wells PL2-604A, PL2-605AR, PL2-606A, and PL2-332A. Benzene concentrations decreased after EHC-O™ injection in samples from wells PL2-310A and PL2-311A but more recent data indicate steady or perhaps slightly increased concentrations.

Toluene, ethylbenzene, m,p-xylene, and o-xylene were detected in samples from several wells at concentrations less than applicable SLs and dTMCLs and concentration trends for these compounds were generally decreasing.

Successful remedial progress has been demonstrated for large areas of contamination based on analytical data, which document decreases in contaminant concentrations in groundwater. Field measured dissolved oxygen and oxidation-reduction potential (ORP) measurements are not at optimal levels for continued EAD. However, the residual impacted soil surrounding underground utilities at OA-9 will be excavated and transported for offsite disposal following the planned demolition of Building 2-44 and Building 2-49 and surrounding areas. Those excavations will directly remove TPH and benzene impacted soil source material at OA-9 more efficiently and effectively than further indirect soil remediation provided by continued operation of the bioventing system.

Table 1 respirometry test data indicate little or no oxygen consumption by microorganisms at PL2-311A, PL2-604A, and PL2-606A. Little or no vadose zone biological activity is happening at these locations and little or no contaminant destruction is ongoing. The respirometry test data indicate that bacterial consumption of oxygen has decreased to a rate that is not measurable by the respirometry testing procedure. The decrease in oxygen consumption rate indicates that contaminated soil within the bioventing zone of influence has likely been remediated to the extent that the residual contaminant mass is no longer sufficient to support measureable aerobic bacterial activity.

Attachment D contains copies of field logbook notes for both groundwater sampling and respirometry test events and Attachment E contains data validation reports for the fifth and sixth quarterly sampling events.

## 5.0 CONCLUSIONS

TPH and BTEX concentrations in groundwater performance samples have declined in five of six wells in the OA-9 IM monitoring well network after one-and-one-half years of remedial treatment. Samples from wells PL2-310A and PL2-311A exhibit declining concentrations of most constituents but TPH-G and benzene remain at concentrations greater than Plant 2 screening levels likely indicating that the injected oxygen-release compound has been consumed and that the driving force for EAD is depleted. The dashed blue line in Figure 5 indicates and estimated extent of groundwater impacts as of April 2010.

Respirometry test data are variable, likely as a result of the heterogeneous distribution of contaminants in the vadose zone. As noted in Section 1.0, underground utilities, and imported backfill material create increased heterogeneity by forming both barriers and preferential pathways to subsurface air distribution by the bioventing system.

The oxygen decline curve and oxygen consumption rate at PL2-311A was significant for four quarters, but the rate of change has decreased to near zero for more recent quarters. The oxygen decline curves for PL2-604A and PL2-606A have also decreased to zero. This indicates that there is little to no microbiological activity within the area of influence of each well. The decrease in oxygen consumption rate indicates that contaminated soil within the bioventing zone of influence has likely been remediated to the extent that the residual contaminant mass is no longer sufficient to support measureable aerobic bacterial activity.

The data collected indicate that after six quarters of operation, bioventing and EAD remedial mechanisms have operated as planned to decrease the contaminant mass by increasing the rate of contaminant destruction in OA-9 vadose zone soil and groundwater. Heterogeneity of subsurface air flow pathways and contaminant source areas increases the variability of respirometry and performance monitoring data, making definitive spatial data evaluation more challenging.

In June 2010 the OA-9 IM will cease operation in preparation for the Building 2-44 and Building 2-49 demolition. Aboveground bioventing equipment will be disconnected and removed from the area. All OA-9 IM wells will be decommissioned according to applicable regulations. Remaining contamination surrounding subsurface utilities in the area will be excavated and removed as part of demolition of those utilities. Soil screening and sampling will be conducted and remaining petroleum-impacted soil with contaminant concentrations greater than cleanup levels will be excavated and appropriately disposed as part of demolition work.

## 6.0 SCHEDULE

The schedule below indicates the end of the active current OA-9 IM remedial operation in June 2010.

**Schedule for OA-9 IM**

IM Decommissioning	June 2010	End of IM Operation
--------------------	-----------	---------------------

## **7.0 REFERENCES**

- EPI, 2006      Environmental Partners, Inc. “2-60s Area Data Gap Investigation Report.” Boeing Plant 2. Seattle/Tukwila, Washington. August 2006.
- EPI, 2008      Environmental Partners, Inc. “Interim Measure Work Plan for Other Area 9.” Boeing Plant 2. Seattle/Tukwila, Washington. July 7, 2008.
- EPI, 2009      Environmental Partners, Inc. “Other Area 9 Interim Measure – First Semiannual Report.” Boeing Plant 2. Seattle/Tukwila, Washington. June 26, 2009.
- EPI, 2010      Environmental Partners, Inc. “Other Area 9 Interim Measure – Second Semiannual Report.” Boeing Plant 2. Seattle/Tukwila, Washington. January 29, 2010.

## TABLES

**Table 1. OA-9 IM Respirometry Test Results**

Event	Date	Injection Air Flow Rate (SCFH)*	Well Tested and Oxygen Consumption Rate					
			Well	% / hour	Well	% / hour	Well	% / hour
System Start	12/15/08	40	NA	NA	NA	NA	NA	NA
Initial System Test	1/12/09	40	PL2-310A	anomalous results	PL2-311A	0.15	PL2-606A	0.23
1st Quarter Test	1/30/09	40	PL2-604A	0	PL2-311A	2.07	PL2-606A	0.19
Operating Adjustment	3/3/09	90	NA	NA	NA	NA	NA	NA
2nd Quarter Test	4/29/09	90	PL2-604A	0	PL2-311A	1.59	PL2-606A	0.07
3rd Quarter Test	7/14/09	90	PL2-604A	0.04	PL2-311A	1.46	PL2-606A	0.05
4th Quarter Test	10/13/09	90	PL2-604A	0.05	PL2-311A	1.71	PL2-606A	0.09
5th Quarter Test	1/15/10	90	PL2-604A	0	PL2-311A	0	PL2-606A	0
6th Quarter Test	4/13/10	90	PL2-604A	0	PL2-311A	0.09	PL2-606A	0

**Notes:**

\* air rate injected into each of nine bioventing wells

NA = not applicable

SCFH = standard cubic feet per hour

**Table 2. OA-9 IM 5th Quarter Groundwater Analytical Data Summary (January 2010)**

Well	Date	NWTPH-Gx (mg/L)	NWTPH-Dx (mg/L)		BTEX VOCs (µg/L)				
			Diesel	Motor oil	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
PL2-310A	1/28/10	6.5	0.30	<0.50	3.8	5.5	55	57	12
PL2-311A	1/28/10	5.1	<0.25	<0.50	210	11	160	100	20
PL2-311A (dup)	1/28/10	5.2	<0.25	<0.50	210	11	150	95	18
PL2-332A	1/28/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
PL2-604A	1/28/10	0.99	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
PL2-605AR	1/28/10	0.48	<0.25	<0.50	0.4	0.5	4.8	1.6	<0.2
PL2-606A	1/28/10	<0.25	<0.25	<0.50	<0.2	<0.2	0.3	0.4	<0.2
Screening Level (2004)		0.8	0.5	0.5	4.48	*	2,100	*	*
dTMCL		NA	NA	NA	2.0	*	30	*	*

**Notes:**

\* = not a COC at Plant 2

< = not detected at the value indicated

mg/L = milligrams per liter

µg/L = micrograms per liter

BTEX = benzene, toluene, ethylbenzene, and xylene

dTMCL = draft Target Media Cleanup Level

NA = not applicable

NWTPH-Dx = Northwest Total Petroleum hydrocarbons - diesel range extended

NWTPH-Gx = Northwest Total Petroleum Hydrocarbons - gasoline range



**Table 3. OA-9 IM 6th Quarter Groundwater Analytical Data Summary (April 2010)**

Well	Date	NWTPH-Gx (mg/L)	NWTPH-Dx (mg/L)		BTEX VOCs (µg/L)				
			Diesel	Motor oil	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
PL2-310A	4/27/10	4.8	<0.25	<0.50	39	2.6	200	3.2	0.3
PL2-311A	4/27/10	6.2	<0.25	<0.50	180	11	160	100	24
PL2-311A (dup)	4/27/10	6.3	<0.25	<0.50	200	12	200	110	26
PL2-332A	4/27/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
PL2-604A	4/27/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
PL2-605AR	4/29/10	<0.25	<0.25	<0.50	<0.2	<0.2	1.6	<0.4	0.4
PL2-606A	4/29/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
Screening Level (2004)		0.8	0.5	0.5	4.48	*	2,100	*	*
dTMCL		NA	NA	NA	2.0	*	30	*	*

**Notes:**

\* = not a COC at Plant 2

< = not detected at the value indicated

mg/L = milligrams per liter

µg/L = micrograms per liter

BTEX = benzene, toluene, ethylbenzene, and xylene

dTMCL = draft Target Media Cleanup Level

NA = not applicable

NWTPH-Dx = Northwest Total Petroleum hydrocarbons - diesel range extended

NWTPH-Gx = Northwest Total Petroleum Hydrocarbons - gasoline range

Table 4. OA-9 IM Groundwater Monitoring Analytical and Field Parameter Data Summary

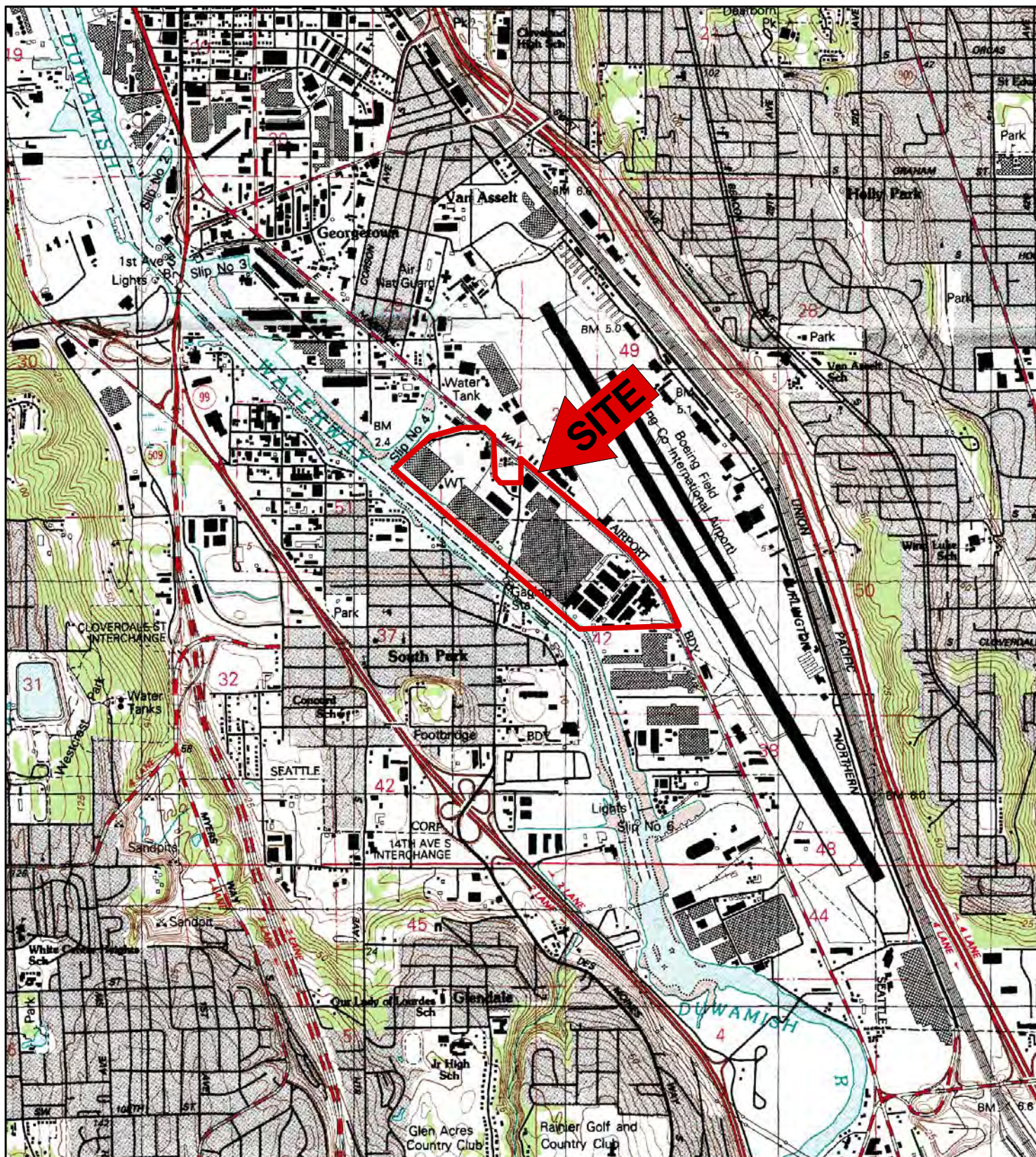
Well	Event	Date	NWTPH-Gx (mg/L)	NWTPH-Dx (mg/L)		BTEX VOCs (µg/L)					Field Parameters						
				Diesel	Motor oil	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temp (°C)	Turbidity (NTU)	Specific Conductance (mS/cm)	Depth to Water (feet)
PL2-310A	Baseline	9/25/08	5.6	<0.25	<0.50	28	2.3	310	2.7	0.4	6.35	0.1	-26	17.4	30.5	10.06	11.35
	1st Quarter	1/27/09	14.0	<0.25	<0.50	39	10	340	48	13	5.92	0.5	-135	12.4	12.1	0.89	10.84
	2nd Quarter	4/27/09	11	0.44	<0.50	27	12	540	50	6.4	6.37	0.3	-175	12.9	14.7	1.75	10.82
	3rd Quarter	7/27/09	7.5	<0.25	<0.50	17	6.2	180	19	2.6	6.67	0.2	-37	17.4	0.2	3.10	11.30
	3rd Quarter (dup)	7/27/09	7.6	0.26	<0.50	17	6.2	170	19	2.7	---	---	---	---	---	---	---
	4th Quarter	10/27/09	7.4	0.29	<0.50	16	3.3	360	10	<2.0	6.43	0.6	-91	18.1	1.3	6.89	11.09
	5th Quarter	1/28/10	6.5	0.30	<0.50	3.8	5.5	55	57	12	6.35	0.3	-3	13.9	8.1	2.06	9.40
	6th Quarter	4/27/10	4.8	<0.25	<0.50	39	2.6	200	3.2	0.3	6.56	0.4	-86	15.1	3.2	2.46	10.38
PL2-311A	Baseline	9/25/08	15	0.40	<0.50	19	27	730	700	140	6.19	0.1	-48	17.0	9.4	10.29	10.87
	1st Quarter	1/27/09	11	0.29	<0.50	190	28	310	300	43	10.67*	0.5	-182	14.8	11.5	5.02	10.55
	1st Quarter (dup)	1/27/09	14	0.26	<0.50	200	27	310	300	45	---	---	---	---	---	---	---
	2nd Quarter	4/27/09	8.4	0.32	<0.50	440	23	340	250	38	6.90	0.3	-176	16.0	9.6	7.85	10.75
	2nd Quarter (dup)	4/27/09	8.7	0.35	<0.50	430	23	360	250	38	---	---	---	---	---	---	---
	3rd Quarter	7/27/09	6.5	<0.25	<0.50	150	11	98	72	20	7.19	0.2	-113	17.2	8.2	3.18	11.19
	4th Quarter	10/27/09	6.1	<0.25	<0.50	150	11	200	76	20	7.34	0.9	-96	17.6	8.8	4.48	10.97
	5th Quarter	1/28/10	5.1	<0.25	<0.50	210	11	160	100	20	7.03	0.3	-123	14.9	6.7	4.40	9.59
	5th Quarter (dup)	1/28/10	5.2	<0.25	<0.50	210	11	150	95	18	---	---	---	---	---	---	---
	6th Quarter	4/27/10	6.2	<0.25	<0.50	180	11	160	100	24	7.09	0.4	-166	14.8	4.4	2.96	10.24
	6th Quarter (dup)	4/27/10	6.3	<0.25	<0.50	200	12	200	110	26	---	---	---	---	---	---	---
PL2-332A	Baseline	9/26/08	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.64	0.1	51	17.1	0.0	0.39	11.12
	1st Quarter	1/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	5.33	0.8	-8	13.9	0.4	0.47	10.78
	2nd Quarter	4/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	5.45	0.6	16	13.1	0.8	1.00	11.91
	3rd Quarter	7/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.22	0.4	104	16.1	0.0	0.58	11.21
	4th Quarter	10/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	5.88	1.7	72	17.0	0.9	0.61	10.82
	5th Quarter	1/28/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.09	0.7	80	14.8	2.9	0.51	9.51
	6th Quarter	4/27/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.39	0.6	106	14.3	0.6	0.56	10.51
PL2-604A	Baseline	9/25/08	0.50	<0.25	<0.50	0.5	<0.2	<0.2	<0.4	<0.2	6.92	0.1	-43	16.1	14.6	3.03	11.37
	1st Quarter	1/27/09	<0.25	<0.25	<0.50	25	<0.6	<0.6	<1.2	<0.6	6.11	0.4	-156	13.4	28.7	1.19	11.00
	2nd Quarter	4/27/09	0.33	<0.25	<0.50	26	0.6	0.3	0.5	<0.2	6.42	6.3	-137	13.1	10.0	2.42	10.96
	3rd Quarter	7/27/09	0.36	<0.25	<0.50	0.6	<0.2	0.6	<0.4	<0.2	7.06	0.2	-125	15.7	3.3	1.23	11.47
	4th Quarter	10/27/09	0.56	<0.25	<0.50	4.1	<0.2	<0.2	<0.4	<0.2	7.00	0.7	-113	16.8	5.4	2.74	11.24
	5th Quarter	1/28/10	0.99	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.71	0.2	-75	14.8	7.3	1.53	9.54
	6th Quarter	4/27/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.72	0.9	-105	15.1	9.6	0.99	10.54
PL2-605AR	Baseline	9/25/08	0.30	<0.25	<0.50	0.5	<0.2	<0.2	<0.4	<0.2	6.61	0.1	15	16.3	7.5	3.80	11.16
	Baseline (dup)	9/25/08	0.31	<0.25	<0.50	0.5	<0.2	<0.2	<0.4	<0.2	---	---	---	---	---	---	---
	1st Quarter	1/29/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	7.64	17.0**	94	14.2	12.1	1.37	10.50
	2nd Quarter	4/27/09	0.43	<0.25	<0.50	0.6	0.5	4.7	1.8	<0.2	6.29	0.2	-111	14.6	68.4	4.18	10.72
	3rd Quarter	7/27/09	0.58	<0.25	<0.50	0.3	0.5	2.5	1.6	<0.2	6.98	0.2	-99	15.8	33.2	2.34	11.22
	4th Quarter	10/27/09	0.51	<0.25	<0.50	0.6	0.3	0.3	1.3	<0.2	7.05	0.5	-86	16.1	13.9	2.83	11.00
	5th Quarter	1/28/10	0.48	<0.25	<0.50	0.4	0.5	4.8	1.6	<0.2	6.69	0.4	-20	14.4	28.4	2.81	9.39
	6th Quarter	4/29/10	<0.25	<0.25	<0.50	<0.2	<0.2	1.6	<0.4	0.4	7.50	0.5	-76	15.0	9.5	2.10	10.34
PL2-606A	Baseline	9/26/08	1.9	<0.25	<0.50	17	3.7	110	17	2.5	6.91	0.2	-38	16.5	0.0	1.02	11.17
	1st Quarter	1/29/09	<0.25	<0.25	<0.50	0.6	<0.2	2.8	0.6	<0.2	8.21	11.4**	23	15.9	18.5	0.95	11.30
	2nd Quarter	4/27/09	<0.25	<0.25	<0.50	0.6	<0.2	1.3	0.5	<0.2	9.36	3.6	-81	15.3	8.0	1.88	10.75
	3rd Quarter	7/27/09	<0.25	<0.25	<0.50	0.4	<0.2	0.4	<0.4	<0.2	8.34	3.6	41	16.6	2.8	0.77	11.39
	4th Quarter	10/27/09	<0.25	<0.25	<0.50	0.5	<0.2	0.4	<0.4	<0.2	10.07	15.3	74	16.5	24.8	0.85	11.12
	4th Quarter (dup)	10/27/09	<0.25	<0.25	<0.50	0.5	<0.2	0.4	<0.4	<0.2	---	---	---	---	---	---	---
	5th Quarter	1/28/10	<0.25	<0.25	<0.50	<0.2	<0.2	0.3	0.4	<0.2	9.71	4.3	66	14.8	8.5	1.41	9.42
	6th Quarter	4/29/10	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	9.12	14.7	133	14.6	15.4	0.75	10.80
Screening Level (2004)			0.8	0.5	0.5	4.48	*	2,100	*	*							
dTMCL			NA	NA	NA	2.0	*	30	*	*							

**Groundwater Notes:**  
\* = not a groundwater COC at Plant 2  
< = not detected at the reporting limit indicated  
mg/L = milligrams per liter  
µg/L = micrograms per liter  
BTEX = benzene, toluene, ethylbenze, and xylene  
dTMCL = draft Target Media Screening Level  
NA = not applicable  
NWTPH-Gx = Northwest Total Petroleum Hydrocarbons – gasoline range  
NWTPH-Dx = Northwest Total Petroleum hydrocarbons – diesel range extended  
VOC = volatile organic compound

**Field Parameter Notes:**  
\* reading verified by second instrument  
\*\* water was effervescing, may have been supersaturated  
--- duplicate sample  
°C = degrees Celsius  
mg/L = milligrams per liter  
mS/cm - milliSiemens per centimeter  
mV = millivolts  
BTEX = benzene, toluene, ethylbenzene, and xylene  
NTU = nephelometric turbidity units  
ORP = oxidation-reduction potential  
VOC = volatile organic compound

## FIGURES





KEY:



SOURCE: USGS 7.5 MINUTE QUADRANGLE  
(TOPOGRAPHIC)

SEATTLE SOUTH  
1983

SCALE = 1:25,000



**ENVIRONMENTAL  
PARTNERS INC**

295 NE Gilman Boulevard, Suite 201  
Issaquah, Washington 98027

FIGURE 1

BOEING PLANT 2  
GENERAL LOCATION

PROJECT	OA-9 IM SEMIANNUAL REPORT		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
SHEET 1 of 1	DRAWN BY ARM	REVIEWED BY JLD	DATE 01/13/10





KEY:



0 100 200 400

APPROXIMATE SCALE: 1" = 400'

- OA-9 IM LOCATION
- PLANT 2 BOUNDARY



**ENVIRONMENTAL  
PARTNERS INC**

295 NE Gilman Boulevard, Suite 201  
Issaquah, Washington 98027

FIGURE 2

GENERAL LOCATION OF THE  
OA-9 IM

<b>PROJECT</b>	OA-9 IM SEMIANNUAL REPORT		
<b>PREPARED FOR</b>	THE BOEING COMPANY		
<b>LOCATION</b>	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
<b>SHEET</b> 1 of 1	<b>DRAWN BY</b> ARM	<b>REVIEWED BY</b> JLD	<b>DATE</b> 01/05/10

APPROXIMATE GROUNDWATER  
FLOW DIRECTION



BUILDING 2-44

OA-9 FORMER USTs  
PL-16, -17, -18

SWMU 78.6 FORMER  
OIL-WATER SEPARATOR

SW-39 (2003)			
EtBz	3'	9,100	µg/kg

PL2-605A (2005)			
All Non-Detect			

PL2-311A (1993)			
TPH-G	5'	9,100	mg/kg
TPH-G	10'	15,000	mg/kg
Benz	5'	2,000	µg/kg
EtBz	5'	28,000	µg/kg
EtBz	8'	1,300	µg/kg

PL2-606A (2005)			
TPH-G	10'	3,900	mg/kg
TPH-D	10'	330	mg/kg
EtBz	10'	13,000	µg/kg

SB-04412 (1994)			
TPH-G	5'	140	mg/kg
TPH-G	8'	48	mg/kg

FORMER  
BUILDING 2-64

SWMU 78.C OIL/WATER  
SEPARATOR

SB-04418 (1994)			
TPH-G	5'	10	mg/kg
Benz	5'	60	µg/kg
Benz	8'	4.7	µg/kg
EtBz	5'	200	µg/kg
EtBz	8'	6.5	µg/kg

SWMU 2-65.50  
MACHINE PIT

APPROXIMATE EXTENT OF  
SOIL CONTAMINATION

FORMER BUILDING 2-65

BUILDING 2-51

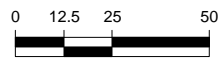
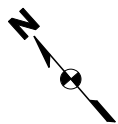
PL2-310A (1993)			
TPH-G	10'	110	mg/kg

SB-04417 (1994)			
Benz	10'	84	µg/kg
EtBz	10'	68	µg/kg

PL2-604A (2005)			
TPH-G	1'	9.9	mg/kg
TPH-D	1'	76	mg/kg
TPH-D	5'	97	mg/kg
TPH-G	9'	19	mg/kg
TPH-D	9'	7.7	mg/kg

PL2-332A

KEY:



SCALE: 1" = 50'



MONITORING WELL



SOIL BORING

WELL OR BORING (SAMPLE DATE)		
ANALYTE	DEPTH BGS	RESULTS



APPROXIMATE EXTENT OF SOIL CONTAMINATION

TPH-G = TPH GASOLINE  
TPH-D = TPH DIESEL  
Benz = BENZENE  
EtBz = ETHYLBENZENE

mg/kg = MILLIGRAMS PER KILOGRAM  
µg/kg = MICROGRAMS PER KILOGRAM



**ENVIRONMENTAL  
PARTNERS INC**

295 NE Gilman Boulevard, Suite 201  
Issaquah, Washington 98027

FIGURE 3

OA-9 IM  
APPROXIMATE EXTENT OF  
SOIL CONTAMINATION

**PROJECT**

OA-9 IM SEMIANNUAL REPORT

**PREPARED  
FOR**

THE BOEING COMPANY

**LOCATION**

BOEING PLANT 2  
SEATTLE/TUKWILA, WASHINGTON

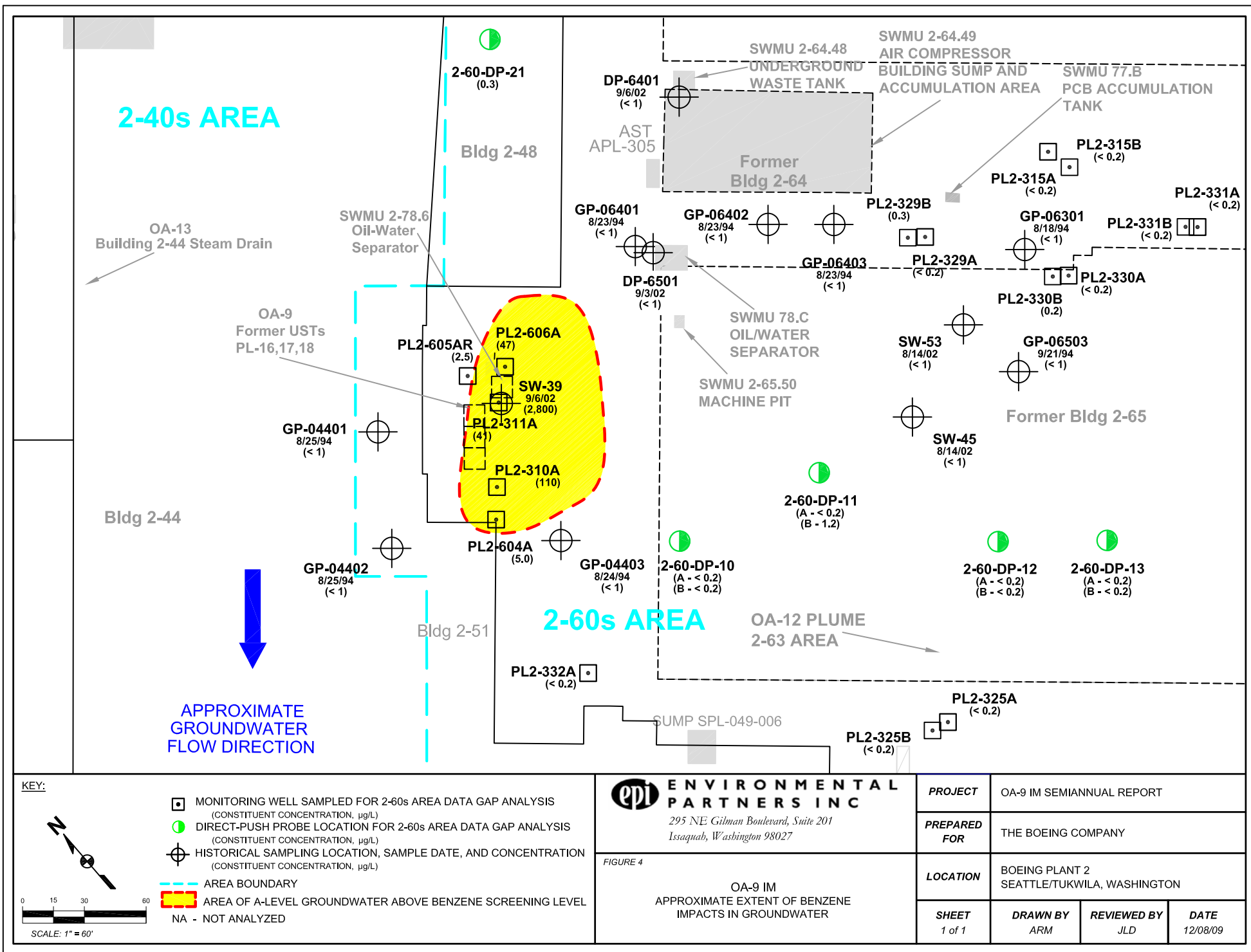
**SHEET**  
1 of 1

**DRAWN BY**  
ARM

**REVIEWED BY**  
JLD

**DATE**  
12/08/09





**APPROXIMATE GROUNDWATER  
FLOW DIRECTION**



**BUILDING 2-44**

**SWMU 78.6 FORMER  
OIL-WATER SEPARATOR**

**SWMU 78.C OIL/WATER  
SEPARATOR**

**SWMU 2-65.50  
MACHINE PIT**

**OA-9 FORMER USTs  
PL-16, -17, -18**

**BIOVENTING  
BLOWER  
TRAILER**

PL2-605AR

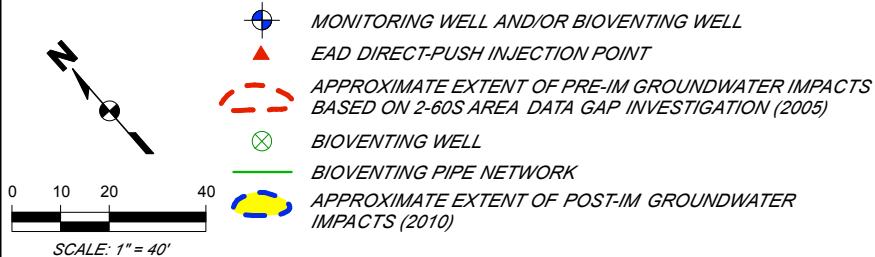
PL2-606A

PL2-604A

**BUILDING 2-51**

**FORMER BUILDING 2-65**

PL2-332A



**ENVIRONMENTAL  
PARTNERS INC**

295 NE Gilman Boulevard, Suite 201  
Issaquah, Washington 98027

**FIGURE 5**

**PRE- AND POST-IM  
OA-9 IM GROUNDWATER IMPACTS,  
EAD INJECTION LOCATIONS, AND  
BIOVENTING SYSTEM**

**PROJECT**

OA-9 IM SEMIANNUAL REPORT

**PREPARED  
FOR**

THE BOEING COMPANY

**LOCATION**

BOEING PLANT 2  
SEATTLE/TUKWILA, WASHINGTON

**SHEET  
1 of 1**

**DRAWN BY  
ARM**

**REVIEWED BY  
JLD**

**DATE  
07/09/10**



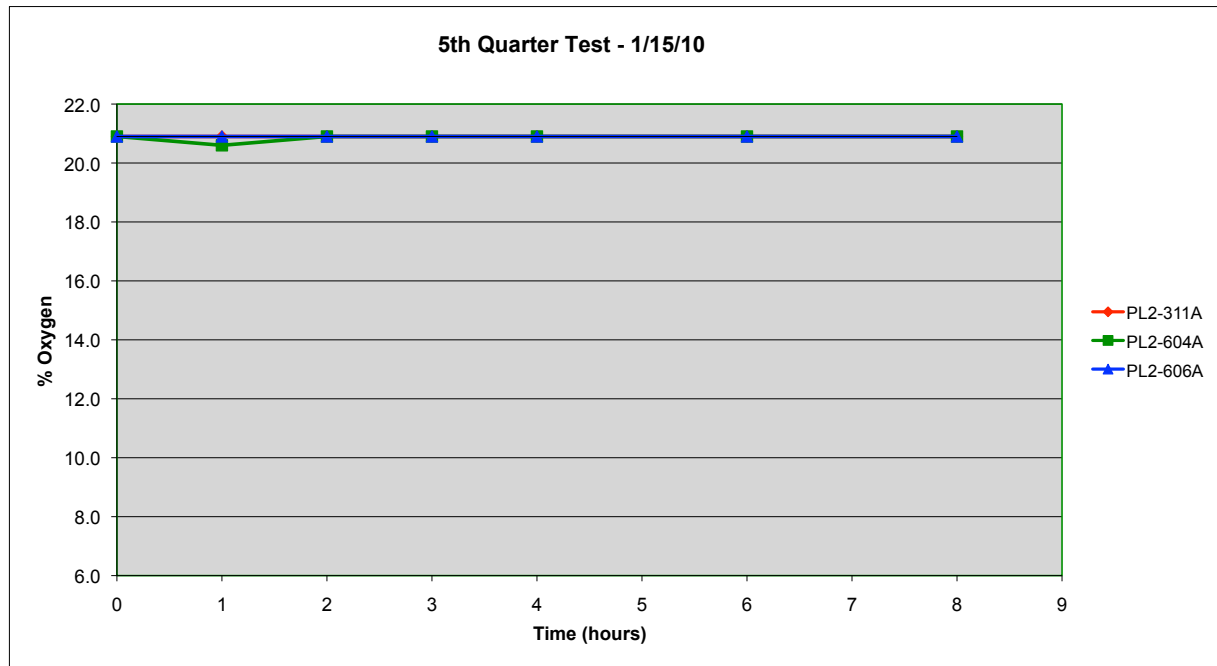
**ATTACHMENT A**  
**RESPIROMETRY TEST DATA AND OXYGEN CURVES**

**OA-9 IM, Boeing Plant 2**  
**5th Quarter Respirometry Test Data and Analysis**

Time	Measured % Oxygen		
	PL2-311A	PL2-604A	PL2-606A
0	20.9	20.9	20.9
1	20.9	20.6	20.9
2	20.9	20.9	20.9
3	20.9	20.9	20.9
4	20.9	20.9	20.9
6	20.9	20.9	20.9
8	20.9	20.9	20.9
	(red)	(green)	(blue)

Bioventing start date > 12/15/2008  
 5th Quarter test date > 1/15/2010

	PL2-311A	PL2-604A	PL2-606A
Screen	8 to	6 to	6 to
Interval	18 ft bgs	21 ft bgs	21 ft bgs
Water Depth	9.59 ft bgs	9.54 ft bgs	9.42 ft bgs



Well	Comment
PL2-311A	The data are different from previous tests; there was no large oxygen concentration decrease at one hour. Over the whole test period there was no measured oxygen concentration decrease. No oxygen consumption rate can be calculated.
PL2-604A	There is no oxygen concentration decrease over 8 hours. There may be no remaining vadose soil contamination at this well or the screen may be covered by water. No oxygen consumption rate can be calculated.
PL2-606A	There is no oxygen concentration decrease over 8 hours. There may be no remaining vadose soil contamination or the screen may be covered by water. No oxygen consumption rate can be calculated.

Note: On March 3, 2009 the air injection rate was increased from 40 SCFH to 90 SCFH.

Oxygen Consumption Rate (0 to 6 hours)				
PL2-311A	0.00	%O <sub>2</sub> /hour	(red)	use this rate for 10% of contaminated volume
PL2-604A	0.00	%O <sub>2</sub> /hour	(green)	
PL2-606A	0.00	%O <sub>2</sub> /hour	(blue)	use this rate for 90 % of contaminated volume

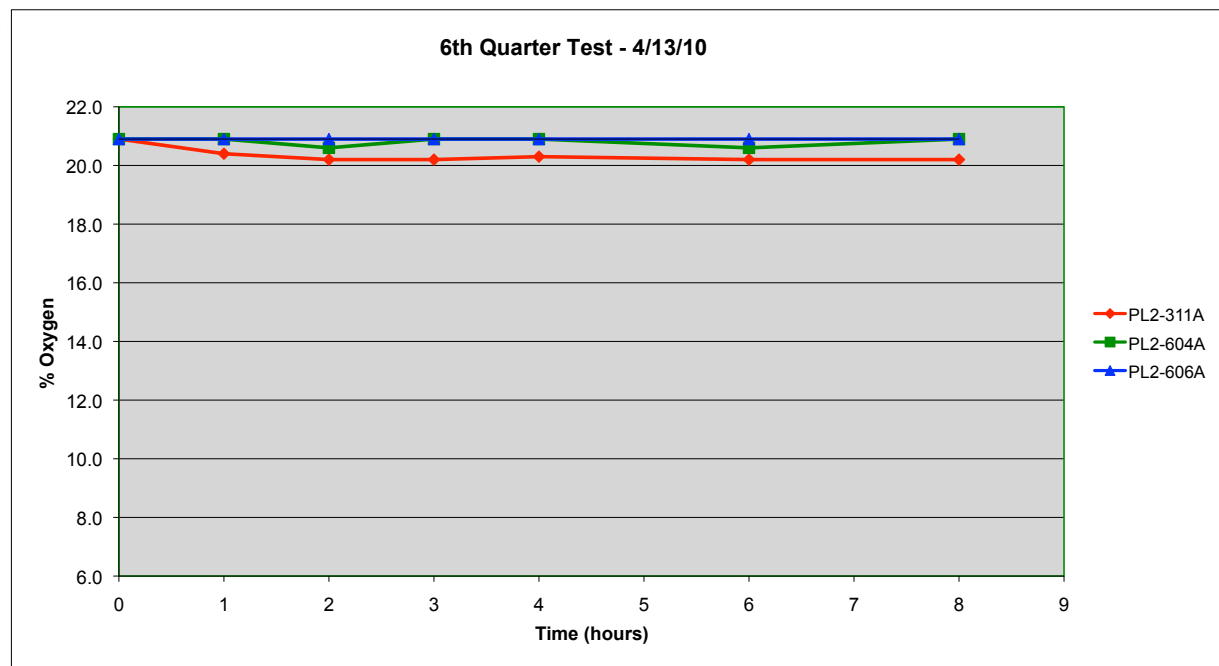
Bioventing Operation Data			OA-9 IM Site Data (soil)		
Run Time > (incremental)	94	days	Contaminated Width	80	feet
(from 10/13/09)	2256	hours	Contaminated Length	120	feet
Air Injection Rate (avg.) >	40	ft <sup>3</sup> /hour	Contaminated Depth	10	feet
	90	ft <sup>3</sup> /hour	Contaminated Volume	96,000	feet <sup>3</sup>
		(until 3/3/09)			
		(after 3/3/09)			
Number of Inj. Wells >	9	wells	Air-filled Pore Fraction	0.25	
Air Density >	0.0743	lb air/ft <sup>3</sup>	Air-filled Pore Volume	24,000	feet <sup>3</sup>
Total Inj. Air >	135,773	lb air	Pore Volume O <sub>2</sub>	373	lbs
Total Inj. O <sub>2</sub> >	28,377	lb O <sub>2</sub>	O <sub>2</sub> Consumed	0.00	lb O <sub>2</sub> consumed/hour

**OA-9 IM, Boeing Plant 2**  
**6th Quarter Respirometry Test Data and Analysis**

Time	Measured % Oxygen		
	PL2-311A	PL2-604A	PL2-606A
0	20.9	20.9	20.9
1	20.4	20.9	20.9
2	20.2	20.6	20.9
3	20.2	20.9	20.9
4	20.3	20.9	20.9
6	20.2	20.6	20.9
8	20.2	20.9	20.9
	(red)	(green)	(blue)

Bioventing start date > 12/15/2008  
6th Quarter test date > 4/13/2010

	PL2-311A	PL2-604A	PL2-606A
Screen	8 to	6 to	6 to
Interval	18 ft bgs	21 ft bgs	21 ft bgs
Water Depth	10.22 ft bgs	10.48 ft bgs	10.32 ft bgs



Well	Comment
PL2-311A	The data are different from previous tests in that there was no large decrease in oxygen concentration at one hour. There was a small oxygen concentration decrease. An oxygen consumption rate can be calculated.
PL2-604A	There is no oxygen concentration decrease over 8 hours. There may be no remaining vadose soil contamination at this well. No oxygen consumption rate can be calculated.
PL2-606A	There is no oxygen concentration decrease over 8 hours. There may be no remaining vadose soil contamination. No oxygen consumption rate can be calculated.

Note: On March 3, 2009 the air injection rate was increased from 40 SCFH to 90 SCFH.

<u>Oxygen Consumption Rate (0 to 8 hours)</u>					
PL2-311A	0.09	%O <sub>2</sub> /hour	(red)	use this rate for 10% of contaminated volume	0.1
PL2-604A	0.00	%O <sub>2</sub> /hour	(green)	use this rate for 90 % of contaminated volume	0.9
PL2-606A	0.00	%O <sub>2</sub> /hour	(blue)		

Bioventing Operation Data			OA-9 IM Site Data (soil)		
Run Time > (incremental)	88	days	Contaminated Width	80	feet
(from 1/15/10)	2112	hours	Contaminated Length	120	feet
Air Injection Rate (avg.) >	40	ft <sup>3</sup> /hour	Contaminated Depth	10	feet
	90	ft <sup>3</sup> /hour			
		(until 3/3/09)			
		(after 3/3/09)	Contaminated Volume	96,000	feet <sup>3</sup>
Number of Inj. Wells >	9	wells			
Air Density >	0.0743	lb air/ft <sup>3</sup>	Air-filled Pore Fraction	0.25	
Total Inj. Air >	127,106	lb air	Air-filled Pore Volume	24,000	feet <sup>3</sup>
Total Inj. O <sub>2</sub> >	26,565	lb O <sub>2</sub>	Pore Volume O <sub>2</sub>	373	lbs
			O <sub>2</sub> Consumed	0.01	lb O <sub>2</sub> consumed/hour

**ATTACHMENT B**  
**GROUNDWATER VOC ANALYTICAL DATA – ALL DETECTIONS**

**Table B1. OA-9 Interim Measure 5th Quarter Analytical Data - All Detections**  
**Boeing, Plant 2**

**Groundwater**

Constituent	Analytical Method	2004 Screening Level	dTMCL	Laboratory Reporting Limit	PL2-310A 1/28/2010	PL2-311A 1/29/2010	PL2-311A (dup) 1/29/2010	PL2-332A 1/28/2010	PL2-604A 1/28/2010	PL2-605AR 1/28/2010	PL2-606A 1/28/2010
<b>Petroleum Hydrocarbons (mg/L)</b>											
TPH-Gasoline	NWTPH-Gx	800	NA	250	6.5	5.1	5.2	<0.25	0.99	0.48	<0.25
TPH-Diesel	NWTPH-Dx	500	NA	250	0.30	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
TPH-Oil	NWTPH-Dx	500	NA	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
<b>VOCs ( µg/L)</b>											
Benzene	EPA 8260C	4.48	2.0	0.2	3.8	210	210	<0.2	<0.2	0.4	<0.2
Toluene	EPA 8260C	NA	NA	0.2	5.5	11	11	<0.2	<0.2	0.5	<0.2
Ethylbenzene	EPA 8260C	2,100	30	0.2	55	160	150	<0.2	<0.2	4.8	0.3
m,p-Xylenes	EPA 8260C	NA	NA	0.4	57	100	95	<0.4	<0.4	1.6	0.4
o-Xylene	EPA 8260C	40,100	NA	0.2	12	20	18	<0.2	<0.2	<0.2	<0.2
Chloroethane	EPA 8260C	NA	NA	0.2	0.2	1.8	1.4	<0.2	<0.2	0.2	<0.2
Acetone	EPA 8260C	NA	NA	5.0	<5.0	32 M	38 M	<5.0	<5.0	5.1 Q	33 Q
cis-1,2-Dichloroethene	EPA 8260C	1,550	6,800	0.2	<0.2	<0.2	0.7	<0.2	<0.2	0.4	<0.2
Chloroform	EPA 8260C	56.1	NA	0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2
2-Butanone	EPA 8260C	NA	NA	5	<5.0	<5.0	16	<5.0	<5.0	<5.0	9.3

**Notes:**

< = not detected at the listed reporting limit

mg/L = milligrams per liter

µg/L = micrograms per liter

dTMCL = draft Target Media Cleanup Level

M = estimated value based on low spectral match

NA = not applicable

Q = continuing calibration fell outside lower 20 percent limit

**Table B2. OA-9 Interim Measure 6th Quarter Analytical Data - All Detections**  
**Boeing, Plant 2**

**Groundwater**

Constituent	Analytical Method	2004 Screening Level	dTMCL	Laboratory Reporting Limit	PL2-310A 4/27/2010	PL2-311A 4/27/2010	PL2-311A (dup) 4/27/2010	PL2-332A 4/27/2010	PL2-604A 4/27/2010	PL2-605AR 4/29/2010	PL2-606A 4/29/2010
<b>Petroleum Hydrocarbons (mg/L)</b>											
TPH-Gasoline	NWTPH-Gx	800	NA	250	4.8	6.2	6.3	<0.25	<0.25	<0.25	<0.25
TPH-Diesel	NWTPH-Dx	500	NA	250	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
TPH-Oil	NWTPH-Dx	500	NA	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
<b>VOCs ( µg/L)</b>											
Benzene	EPA 8260C	4.48	2.0	0.2	39	180	200	<0.2	<0.2	<0.2	<0.2
Toluene	EPA 8260C	NA	NA	0.2	2.6	11	12	<0.2	<0.2	<0.2	<0.2
Ethylbenzene	EPA 8260C	2,100	30	0.2	200	160	200	<0.2	<0.2	1.6	<0.2
m,p-Xylenes	EPA 8260C	NA	NA	0.4	3.2	100	110	<0.4	<0.4	<0.4	<0.4
o-Xylene	EPA 8260C	40,100	NA	0.2	0.3	24	26	<0.2	<0.2	0.4	<0.2
Chloroethane	EPA 8260C	NA	NA	0.2	<0.2	1.1	<1.0	<0.2	<0.2	<0.2	<0.2
Acetone	EPA 8260C	NA	NA	5.0	<5.0	<25	<25	<5.0	<5.0	<5.0	18
cis-1,2-Dichloroethene	EPA 8260C	1,550	6,800	0.2	<0.2	<1.0	<1.0	<0.2	<0.2	0.5	<0.2
Chloroform	EPA 8260C	56.1	NA	0.2	<0.2	<1.0	<1.0	0.3	<0.2	<0.2	<0.2
2-Butanone	EPA 8260C	NA	NA	5	7.2 M	<25	<25	<5.0	<5.0	<5.0	<5.0

**Notes:**

< = not detected at the listed reporting limit

mg/L = milligrams per liter

µg/L= micrograms per liter

dTMCL = draft Target Media Cleanup Level

M = estimated value based on low spectral match

NA = not applicable

Q = continuing calibration fell outside lower 20 percent limit

**ATTACHMENT C**  
**FIELD PARAMETER DATA**

**Performance Monitoring - 5th Quarter Field Parameter Measurements (1/2010)**

**OA-9 IM - EAD**

<b>Well ID</b>	<b>pH</b>	<b>Dissolved Oxygen (mg/L)</b>	<b>ORP (mV)</b>	<b>Temp (°C)</b>	<b>Turbidity (NTU)</b>	<b>Specific Conductance (mS/cm)</b>	<b>Depth to Water (ft)</b>
PL2-310A	6.35	0.34	-3	13.9	8.1	2.06	9.40
PL2-311A	7.03	0.25	-123	14.9	6.7	4.40	9.59
PL2-332A	6.09	0.73	80	14.8	2.9	0.51	9.51
PL2-604A	6.71	0.22	-75	14.8	7.3	1.53	9.54
PL2-605AR	6.69	0.44	-20	14.4	28.4	2.81	9.39
PL2-606A	9.71	4.31	66	14.8	8.5	1.41	9.42

**Notes:**

°C = degrees Celsius

mg/L = milligrams per liter

mS/cm = milliSiemens per centimeter

mV = millivolts

NTU = nephelometric turbidity units

ORP = oxidation-reduction potential



**Performance Monitoring - 6th Quarter Field Parameter Measurements (4/2010)****OA-9 IM - EAD**

<b>Well ID</b>	<b>pH</b>	<b>Dissolved Oxygen (mg/L)</b>	<b>ORP (mV)</b>	<b>Temp (°C)</b>	<b>Turbidity (NTU)</b>	<b>Specific Conductance (mS/cm)</b>	<b>Depth to Water (ft)</b>
PL2-310A	6.56	0.43	-86	15.1	3.3	2.46	10.38
PL2-311A	7.09	0.41	-166	14.8	4.4	2.96	10.24
PL2-332A	6.39	0.64	106	14.3	0.6	0.56	10.51
PL2-604A	6.72	0.91	-105	15.1	9.6	0.99	10.54
PL2-605AR	7.50	0.54	-76	15.0	9.5	2.10	10.34
PL2-606A	9.12	14.7	133	14.6	15.4	0.75	10.80

**Notes:**

°C = degrees Celsius

mg/L = milligrams per liter

mS/cm = milliSiemens per centimeter

mV = millivolts

NTU = nephelometric turbidity units

ORP = oxidation-reduction potential

**ATTACHMENT D**  
**FIELD NOTES**

Location Boeing Plant 2 Date 1/15/10 33

Project / Client OA-9 Respirirometry Testing  
~45°F Very Windy, Heavy Rain

0800	K. Addis onsite			
0815	Blower system shutdown All valves in trailer + at wells are closed.			
0822	Water Levels			
	606A	311A	604A	Liter purge time
	11.10	1.8	5.4	20.4
	10.98	1.8	5.4	20.4
	11.28	1.8	5.4	20.4

0845 Pump rate = 4 minute purge used to sample  
 Pump = 64/min = 3.4 minute purge calculated

Time	606A	311A	604A
0 hr	—	—	—
0915 1 hr	20.9	20.9	20.9
1015 2 hr	20.6	20.9	20.9
1115 3 hr	20.9	20.9	20.6
1215 4 hr	20.9	20.9	20.9
1415 6 hr	20.6	20.9	20.9
1615 8 hr	20.9	20.9	20.9

1630 All valves at wells are open. Well lids + caps secured. System startup with all valves open.

1700 K. Addis offsite to office to measured O<sub>2</sub> in

34 Location Boeing Plant 2 Date 1/15/10  
 Project / Client OA-9 Respirirometry

dry conditions due to possible O<sub>2</sub> meter malfunction.  
 1745 At office. Unload equipment  
 1815 Begin 5 gas meter check using Both EPI 5 gas meters + INW rental 4 gas meters. 4 gas meter reads 20.6 for standard O<sub>2</sub> content.  
 1930 All gas reading are reading consistent 20.6 to 20.9, which is not typical. Will continue to investigate possible issues with pump. Well 311A typically had O<sub>2</sub> levels from 7% - 13% O<sub>2</sub>. All readings are 20.9. Will need to perform test again once issue is identified.

~~Kristen L. Addis~~  
 1/15/10

Location Boeing Plant Z Date 1/28/10Project / Client OA-9 Qtrly GW Sampling~48°F Partly Cloudy

1700 Completed work from Z-10 Area  
+ need to gather equipment +  
ice for coolers.

1740 Water Levels

Well	DTW
332A	9.51
604A	9.54
310A	9.40
311A	9.59
605AR	9.39
606A	9.42

1745 Begin purge at PL2-332A  
See OA-9 IM Sampling Booklet  
for gw parameters + sampling  
information.

1/29/10 Friday Midnight

0019 Last sample.

0035 Begin cleanup.

Decontaminate all equipment.

All Decon water + purgewater  
are transferred to Z-49

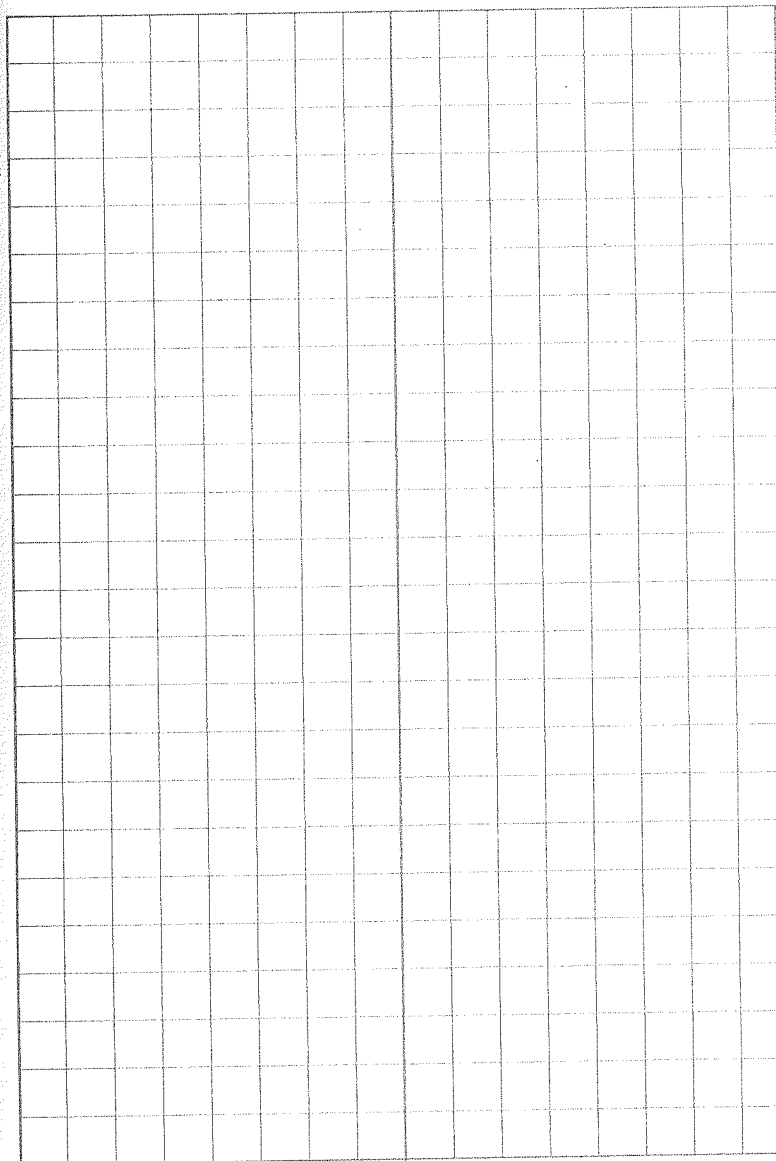
treatment tank. Breakdown Barricades

0130 K. Addis offsite

0200 at office Kristin L. Addis

Location \_\_\_\_\_ Date \_\_\_\_\_

Project / Client \_\_\_\_\_



# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-332A	Date
	Field Team: (Initials)

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume


Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time

1745

End Time

Total Gallons Purged

1745

Time Gallons pH Conductivity NTU DO Temp. ORP Appearance

1800	2.00	5.97	0.514	4.77	0.88	14.37	88.5	clear
1803	2.1	6.00	0.515	3.98	0.89	14.20	86.3	clear
1806	2.3	6.04	0.511	4.01	0.82	14.49	86.0	clear
1809	2.4	6.06	0.507	4.12	0.76	14.88	81.9	clear
1812	2.7	6.08	0.508	2.96	0.73	14.88	81.0	clear
1815	2.9	6.09	0.508	2.88	0.73	14.81	80.4	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1817	(3) 40-mL VOA	HCl, cool to 4°C	
<u>GK</u> TOC (415.1)	1817	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
<u>DX</u> Dissolved gasses (MEE) (RSK-175)	1817	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time

1826

## Comments / Exceptions:

Presence of floating product?

YES / NO

Presence of sinking product?

YES / NO

332A

9.51

Odor sulfur?

604A

9.54

310A

9.40

311A

9.59

605A

9.39

606A

9.42

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-604A

Date 1/28/10

Field Team: (Initials)

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2'

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time 1848

End Time 2000

Total Gallons Purged 3.9

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1859	1.7	6.63	2.206	52.4	0.41	14.98	54.5	clear Cloudy orange
1907	2.5	6.67	1.887	27.3	0.36	14.74	-11.9	clearing
1910	2.6	6.70	1.813	23.9	0.35	14.73	-26.1	clearing
1913	2.7	6.68	1.770	18.4	0.33	14.76	-33.9	clearing
1916	2.9	6.68	1.694	16.3	0.31	14.78	-44.6	clear
1919	3.1	6.68	1.647	14.1	0.29	14.80	-56.2	clear
1922	3.3	6.68	1.587	12.4	0.28	14.83	-61.1	clear
1925	3.4	6.69	1.562	9.86	0.26	14.81	-64.7	clear
1928	3.5	6.69	1.545	9.69	0.25	14.86	-67.8	clear
1931	3.7	6.69	1.527	8.21	0.24	14.93	-72.1	clear
1934	3.8	6.71	1.525	7.33	0.22	14.82	-75.4	clear

## Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1936	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD 9
Gx TOC (415.1)	1936	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	MS/MSD 9
DX Dissolved gases (MEE) (RSK-175)	1936	(3) 40-mL VOA	cool to 4°C	MS/MSD 6
Ferrous Iron (SM3500 Fe B-97)	4/	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time

2000

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Odor - Petro-like

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-310A	Date	1/28/10
	Field Team: (Initials)	KA

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2"

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other :

Start Time

2005

End Time

Total Gallons Purged

2005

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
2022	1.75	6.43	2.055	10.37	0.83	13.95	-6.7	clear
2025	1.9	6.36	2.055	9.15	0.65	13.94	-3.9	clear
2028	2.1	6.33	2.057	8.75	0.59	13.94	-3.4	clear
2031	2.3	6.35	2.061	9.08	0.52	13.91	-2.7	clear
2034	2.4	6.35	2.064	8.65	0.44	13.87	-3.3	clear
2037	2.6	6.34	2.061	8.29	0.39	13.87	-3.1	clear
2040	2.7	6.35	2.059	8.10	0.34	13.87	-2.8	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	2042	(3) 40-mL VOA	HCl, cool to 4°C	
<del>TOC (415-1)</del>	2042	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
<del>Dissolved gases (MEE) (RSK-175)</del>	2042	(3) 40-mL VOA	cool to 4°C	
<del>Ferrous Iron (SM3500 Fe B-97)</del>		250 mL amber	cool to 4°C Do NOT filter	
<del>Anions (EPA-300.0)</del>		(1) 500 mL HDPE	cool to 4°C	
<del>Organics Acids (VFA)</del>		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
<del>Metals (200.8&amp;6010B)</del>		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time

--

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Odor - Petroleum

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.



# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-605AR	Date	1/28/10
Sample: ID		Field Team: (Initials)	KA
Field Conditions			

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2"

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time	2115
End Time	2208
Total Gallons Purged	4.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
2136	2.5	6.71	3.218	45.4	0.78	14.50	-6.1	orange, cloudy
2144	3.2	6.71	3.155	65.1	0.55	14.48	-7.2	orange, cloudy
2149	3.6	6.70	2.990	30.4	0.51	14.44	-12.9	orange, cloudy
2152	3.75	6.69	2.855	30.4	0.46	14.42	-16.8	orange, cloudy
2155	3.9	6.69	2.832	29.6	0.45	14.40	-18.6	clearing
2158	4.1	6.69	2.812	28.4	0.44	14.36	-20.2	clearing

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	2200	(3) 40-mL VOA	HCl, cool to 4°C	
<del>6X</del> TOC (415.1)	2200	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
<del>DX</del> Dissolved Gases (MEE) (RSK-175)	2200	(3) 40-mL VOA	cool to 4°C	
<del>Fe</del> Ferrous Iron (SM3500 Fe B.97)		250 mL amber	cool to 4°C Do NOT filter	
<del>As</del> Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
<del>Organics</del> Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
<del>Metals</del> Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 2208

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.



# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-606A	Date 1/28/10
	Field Team: (Initials) KA

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2"

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other :

Start Time 2210

End Time

Total Gallons Purged

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
2240	2.5	10.46	2.095	10.57	5.26	15.14	-90.8	clear
2243	2.6	10.45	1.739	9.16	5.44	15.12	-73.1	clear
2246	2.7	10.41	1.657	9.71	5.69	15.23	-66.8	clear
2249	2.9	10.29	1.586	10.37	5.45	15.14	-53.1	clear
2252	3.0	10.25	1.568	9.18	5.45	15.12	-45.3	clear
2255	3.2	10.16	1.526	7.70	5.38	15.05	-32.5	clear
2258	3.4	10.09	1.518	8.08	5.27	14.92	-23.9	clear
2301	3.6	10.03	1.458	7.60	5.09	14.92	-9.6	clear
2304	3.8	9.98	1.458	7.80	4.92	14.91	+1.3	clear
2307	4.0	9.92	1.454	7.72	4.80	14.85	16.4	clear
2312	4.2	9.84	1.426	8.42	4.65	14.81	29.2	clear
2315	4.4	9.83	1.421	8.54	4.57	14.79	38.2	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	2328	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)		340 mL VOA 250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C HCl	
Dissolved gases (MEE) (HSE-175)		2 Amber (3) 40-mL VOA	cool to 4°C	
Ferrous Ion (SM3500 Fe 97)		250 mL amber	cool to 4°C Do NOT filter	
Anion (EPA 8210)		(1) 500 mL HDPE	cool to 4°C	
Organics (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Odor - Petroleum  
Begin work at 4:30 ICE

→  
Continue

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Continued

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-606A	Date	1/28/10
Sample: ID		Field Team: (Initials)	KA
Field Conditions			

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume


Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time 2210

End Time 2333

Total Gallons Purged

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
2318	4.6	9.77	1.405	8.52	4.41	14.83	49.8	clear
2321	4.75	9.72	1.408	8.21	4.36	14.80	60.0	clear
2324	4.9	9.71	1.407	8.52	4.31	14.81	65.5	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	2326	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	2326	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gases (MEE) (RSK-175)	2326	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	—	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time

2333

## Comments / Exceptions:

Presence of floating product?

YES / NO

Presence of sinking product?

YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-311A	Date	1/28/10
Sample: ID	09 Dup	Field Team: (Initials)	
Field Conditions	GW-100129~PL2-311A-0 + 1		

## Purge Information

Well Diameter (in.)	
Well Depth (ft.)	
Initial Depth to Water (ft.)	
Depth of Water Column	
3 Casing Volumes	
1 Casing Volume	

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time

1140 KA 2335

End Time

Total Gallons Purged

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
2340	1.0	7.24	5.084	13.1	0.34	14.82	-121.7	clear slight gray tint
2343	1.2	7.11	5.010	12.4	0.31	14.85	-121.5	clear slight gray
2347	1.4	7.12	4.953	10.53	0.29	14.88	-122.9	clear slight gray
2350	1.6	7.10	4.916	11.7	0.28	14.91	-123.8	clear
2353	1.8	7.08	4.838	10.64	0.28	14.98	-125.2	clear
2356	2.0	7.08	4.8755	10.03	0.27	14.97	-126.9	clear
2359	2.3	7.08	4.708	9.64	0.27	14.99	-127.8	clear
0002	2.5	7.07	4.664	9.98	0.27	14.93	-127.8	clear
0005	2.7	7.06	4.600	9.78	0.26	14.92	-127.5	clear
0008	2.9	7.05	4.560	8.42	0.26	14.91	-127.0	clear
0011	3.1	7.05	4.500	7.73	0.25	14.93	-126.4	clear
0014	3.3	7.06	4.440	7.15	0.26	14.91	-125.5	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	2358	(3) 40-mL VOA	HCl, cool to 4°C	Dup
TOC (415.1)	2358	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	Dup
Dissolved gases (MEE) (RSK-175)	2358	(3) 40-mL VOA	cool to 4°C	Dup
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time

## Comments / Exceptions:

Presence of floating product?

YES / NO

Presence of sinking product?

YES / NO

Continue

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Station  
Sample: ID  
Field Conditions

PL2-311A

Date \_\_\_\_\_

Field Team: (Initials)

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

Purge Method : Submersible pump

### Bladder Pump

### Peristaltic Pump

Other: :

Start Time

End Time

Total Gallons Purged

[illegible]

### Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other


Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0019	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	0019	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gases (MEE) (RSK-175)	0019	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time

## Comments / Exceptions:

Presence of floating product?	YES / NO	Presence of sinking product?	YES / NO
-------------------------------	----------	------------------------------	----------

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: <b>01161</b>		Turn-around Requested: <b>Standard</b>		Page: <b>1</b> of <b>1</b>		 <b>Analytical Resources, Incorporated</b> Analytical Chemists and Consultants 4611 South 134th Place, Suite 100 Tukwila, WA 98168 206-695-6200 206-695-6201 (fax)								
ARI Client Company: <b>Boeing</b>		Phone:		Date: <b>1/29/10</b>				Ice Present? <b>yes</b>						
Client Contact: <b>Will Ernst</b>				No. of Coolers: <b>1</b>				Cooler Temps: <b>2.0</b>						
Client Project Name: <b>OA-9 1M Performance Sampling</b>														
Client Project #: <b>17512.2 OA-9</b>		Samplers: <b>K. Addis</b>		Analysis Requested				Notes/Comments						
Sample ID	Date	Time	Matrix	No. Containers	EPA 8260C	VOCs	TPH-Gx	TPH-Dx						
GW-100128-PL2-332A-0	1/28/10	1817	GW	8	X	X	X							
GW-100128-PL2-604A-0		1936		24	X	X	X							MS/MSD
GW-100128-PL2-310A-0		2042		8	X	X	X							
GW-100128-PL2-605AR-0		2200		8	X	X	X							
GW-100128-PL2-606A-0		2328		8	X	X	X							
GW-100129-PL2-311A-0	✓	0019		8	X	X	X							
GW-100129-PL2-311A-1	1/29/10	0019	✓	8	X	X	X							
Trip Blank	↓	-	-	2	X	X								
Comments/Special Instructions					Relinquished by: <b>Kristin L. Addis</b> (Signature)		Received by: <b>D. Peterson</b> (Signature)		Relinquished by: _____ (Signature)		Received by: _____ (Signature)			
					Printed Name: <b>Kristin L. Addis</b>		Printed Name: <b>D. Peterson</b>		Printed Name: _____		Printed Name: _____			
					Company: <b>EPI</b>		Company: <b>ARI</b>		Company: _____		Company: _____			
					Date & Time: <b>1/29/10 1650</b>		Date & Time: <b>1/29/10 1650</b>		Date & Time: _____		Date & Time: _____			

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, notwithstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Location Boeing Plant 2 Date 4/13/10  
 Project / Client OA-9 Respirirometry

0630 Leave office

0720 Onsite

Cone-off entire OA-9 area

0730 Blower turned off. All valves closed in trailer + at wells.

	Water Levels	Vol	3Vol	Liters
606A	10.32	1.7	5.1	19.3
311A	10.22	1.6	4.9	18.5
604A	10.48	1.7	5.1	19.3

Purge rate 6L/min

Purge Times

606A - 3.2 min

311A - 3.1 min

604A - 3.2 min

	606A	311A	604A
0hr	Ambient O <sub>2</sub> reading 20.9		
0830 1 hr	20.9	20.4	20.9
0930 2 hr	20.9	20.2	20.6
1030 3 hr	20.9	20.2	20.9
1130 4 hr	20.9	20.3	20.9
1330 6 hr	20.9	20.2	20.6
1530 8 hr	20.9	20.2	20.9

1545 Begin cleanup. All wells are secured with locking airtight

42

Location Boeing Plant 2 Date 4/13/10  
 Project / Client OA-9 Respirirometry Test

cap. All monuments are secure.  
 1600 Move all barricade to the trailer area + tape off the south + east end of trailer.

1610 Open all valves in trailer. Restart system.

1625 Unload equipment at connex.

1715 At storage in Issaquah. Unload.

1738 At office, unload 5 gas + pump.

1800 Complete OA-9 Resp. work.

Kristen L. Addis  
 4/13/10

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-332A	Date	4/27/10
Sample: ID	GW-100427-PL2-332A-0	Field Team: (Initials)	JB MM
Field Conditions	Sunny, warm		

## Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	19.0
Initial Depth to Water (ft.)	10.51
Depth of Water Column	8.49
3 Casing Volumes	4.08
1 Casing Volume	1.36

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time	0902
End Time	0949
Total Gallons Purged	2.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance/DTW (ft)
0916	0.5	6.62	0.541	1.11	0.80	14.80	109.9	clear / 10.65
0919	0.7	6.54	0.576	0.87	0.72	14.60	109.1	clear / 10.65
0922	0.9	6.50	0.574	0.94	0.73	14.47	108.4	clear / 10.66
0925	1.1	6.45	0.570	0.55	0.66	14.43	107.8	clear / 10.66
0928	1.3	6.43	0.568	0.46	0.64	14.25	107.5	clear / 10.67
0931	1.5	6.40	0.563	0.69	0.64	14.27	107.1	clear / 10.67
0934	1.7	6.39	0.558	0.62	0.64	14.29	106.4	clear / 10.68

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0937	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	0937	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	0937	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 0949

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-604A	Date	4/27/10
Sample: ID	GW-100427-PL2-604A-0	Field Team: (Initials)	JB NM
Field Conditions	Cloudy		

## Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	22.0
Initial Depth to Water (ft.)	10.54
Depth of Water Column	11.46
3 Casing Volumes	5.50
1 Casing Volume	1.83

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time 0951

End Time 1013

Total Gallons Purged 3.6

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance / DTW (ft)
1012	1.0	6.49	0.927	34.4	0.82	15.41	-14.6	clearing / 10.69
1016	1.2	6.53	0.958	23.3	0.79	15.21	-38.9	clearing / 10.71
1020	1.5	6.57	0.969	21.3	0.79	15.12	-57.7	clearing / 10.71
1024	1.7	6.61	0.976	18.7	0.87	15.16	-74.5	clearing / 10.72
1028	2.0	6.64	0.981	17.7	0.93	15.12	-84.9	clear / 10.72
1031	2.2	6.66	0.980	13.4	0.90	15.12	-91.2	clear / 10.73
1034	2.4	6.67	0.988	14.0	0.89	15.13	-95.4	clear / 10.74
1037	2.6	6.69	0.989	12.4	0.92	15.12	-99.1	clear / 10.75
1040	2.8	6.70	0.991	11.4	0.90	15.13	-101.6	clear / 10.76
1043	3.0	6.71	0.987	9.77	0.89	15.10	-103.7	clear / 10.76
1046	3.2	6.72	0.987	9.64	0.91	15.10	-105.4	clear / 10.77

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1049	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
NWTPH-Gx	1049	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
NWTPH-Dx	1049	(2) 0.5 L Amber Glass	cool to 4°C	MS/MSD

End Time

1013

## Comments / Exceptions:

Presence of floating product? YES (NO) Presence of sinking product? YES / (NO)

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.



# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station

PL2-310A

Date

4/27/10

Sample: ID

GW-100427-PL2-310A-0

Field Team: (Initials)

JB MM

Field Conditions

partly Sunny

## Purge Information

Well Diameter (in.)

2

Well Depth (ft.)

19.5

Initial Depth to Water (ft.)

10.38

Depth of Water Column

9.12

3 Casing Volumes

4.38

1 Casing Volume

1.46

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other :

Start Time

1115

End Time

1218

Total Gallons Purged

2.8

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance / DTW (ft)
1141	1.5	6.55	2.550	5.72	0.61	15.22	-71.1	Clear / 10.96
1144	1.7	6.55	2.529	6.59	0.57	15.17	-77.2	Clear / 10.92
1147	1.9	6.55	2.607	4.57	0.51	15.19	-79.9	Clear / 10.92
1150	2.1	6.56	2.470	3.16	0.47	15.11	-80.9	Clear / 10.90
1153	2.2	6.56	2.462	2.99	0.47	15.09	-83.1	Clear / 10.90
1156	2.4	6.56	2.456	3.25	0.43	15.12	-85.7	Clear / 10.91

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1159	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1159	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1159	(2) 0.5 L Amber Glass	cool to 4°C	

End Time

1218

## Comments / Exceptions:

Presence of floating product?

YES / NO

Presence of sinking product?

YES / NO

flow rate: 300ml/min

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-311A  
GW 100427-PL2-311A-0  
Cloudy, cool

Date 4/27/10  
Field Team: (Initials) JB MM

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2  
18.5  
10.24  
8.26  
3.96  
1.32

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time 12:16

End Time

Total Gallons Purged

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance / DTW(ft)
1216	0	Begin	purge					
1242	1.9	6.77	4.714	7.53	0.47	14.46	-96.8	Clear / 11.54
1246	2.2	6.84	4.526	7.44	0.53	14.55	-114.5	Clear / 11.82
1251	2.5	6.92	4.261	7.06	0.45	14.55	-131.9	Clear / 11.53
1300	3.5	6.98	4.024	7.91	0.41	14.52	-147.2	Clear / 11.43
1305	4.0	6.99	3.889	7.78	0.39	14.66	-153.4	Clear / 11.46
1308	4.2	7.01	3.827	7.66	0.39	14.66	-155.9	Clear / 11.46
1311	4.4	7.02	3.751	7.53	0.41	14.67	-158.2	Clear / 11.47
1314	4.5	7.04	3.635	7.27	0.39	14.66	-161.1	Clear / 11.49
1319	4.7	7.05	3.489	5.71	0.38	14.78	-163.3	Clear / 11.50
1322	4.9	7.06	3.414	6.27	0.35	14.77	-164.2	Clear / 11.50
1325	5.0	7.06	3.343	5.46	0.34	14.78	-165.4	Clear / 11.49

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)		(3) 40-mL VOA	HCl, cool to 4°C	Duplicate: GW-100427-PL2-311A-1
NWTPH-Gx		(3) 40-mL VOA	HCl, cool to 4°C	Duplicate
NWTPH-Dx		(2) 0.5 L Amber Glass	cool to 4°C	Duplicate

End Time

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

purge rate: 300ml/min

CONTINUE

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

\* Continued from previous page

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-311A  
GW-100427-PL2-311A-0  
Rainy, cool

Date 4/27/10  
Field Team: (Initials) JB MM

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2  
18.5  
10.24  
8.26  
3.96  
1.32

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time 1216

End Time 1420

Total Gallons Purged 6.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance <sup>DTW(ft)</sup>
1339	5.2	7.08	3.189	4.42	0.34	14.74	-166.1	Clear / 11.51
1334	5.4	7.06	3.133	5.13	0.34	14.68	-165.5	Clear / 11.51
1337	5.6	7.09	3.061	4.81	0.37	14.70	-165.8	Clear / 11.50
1340	5.7	7.09	3.000	4.63	0.36	14.72	-166.2	Clear / 11.50
1343	5.9	7.08	2.979	4.42	0.41	14.75	-166.3	Clear / 11.49
1346	6.1	7.09	2.957	4.37	0.41	14.79	-166.3	Clear / 11.48

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1349/1355	(3) 40-mL VOA	HCl, cool to 4°C	Duplicate: GW-100427-PL2-311A-6
NWTPH-Gx	1349/1355	(3) 40-mL VOA	HCl, cool to 4°C	Duplicate
NWTPH-Dx	1349/1355	(2) 0.5 L Amber Glass	cool to 4°C	Duplicate

End Time 1420

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-600A	Date	4/29/10
Sample: ID	GW-100429-PL2-600A-0	Field Team: (Initials)	JB MM
Field Conditions	cloudy, cool		

## Purge Information

Well Diameter (in.)	2	Purge Method :	Submersible pump
Well Depth (ft.)	22.0		Bladder Pump
Initial Depth to Water (ft.)	10.80 (10.80 on 4/29)		<u>Peristaltic Pump</u>
Depth of Water Column	11.20	Other :	
3 Casing Volumes	5.38	Start Time	0802
1 Casing Volume	1.79	End Time	1008
		Total Gallons Purged	5.2

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	CRP	Appearance/DTW (ft)
0802	0							10.89
0838	1.5	10.89	1,425	5.54	24.41	14.16	-1.1	Clear / 12.51
0841	1.7	10.86	1,313	4.91	23.53	14.20	-0.7	Clear / 12.42
0844	1.9	10.81	1,180	5.13	22.88	14.24	0.4	Clear / 12.34
0847	1.9	10.74	1,095	30.8	21.88	14.24	2.7	Clear / 12.21
0852	2.2	10.53	0,926	32.5	20.17	14.29	14.6	Clear / 12.13
0855	2.3	10.38	0,863	28.7	19.29	14.31	23.4	Clear / 12.08
0859	2.4	10.18	0,808	25.9	18.43	14.32	37.4	Clear / 12.04
0902	2.5	10.06	0,795	27.8	17.80	14.33	44.9	Clear / 12.01
0905	2.7	9.95	0,783	24.4	17.45	14.32	53.4	Clear / 12.00
0908	2.8	9.86	0,778	26.1	17.19	14.32	60.9	Clear / 11.98
0913	3.0	9.73	0,766	23.3	17.11	14.32	72.3	Clear / 11.94

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0957	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	0957	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	0957	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1008

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

flow rate: 200ml/min

Continued on next page →

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

\* Continued from previous page

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-606A  
GW-100429-PL2-606A-0  
cloudy, cool

Date 4/29/10  
Field Team: (Initials) JB MU

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2  
22.0  
10.80 (10.89)  
11.20  
5.38  
1.79

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other: :

Start Time 0802

End Time 1008

Total Gallons Purged 5.2

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance / DTW
0918	3.2	9.62	0.741	21.2	16.35	14.31	79.8	Clear / 11.96
0923	3.4	9.54	0.741	36.5	17.17	14.53	90.8	clear / 12.04
0926	3.5	9.48	0.746	19.6	16.77	14.49	97.2	Clear / 12.20
0929	3.7	9.43	0.751	15.4	16.86	14.45	102.5	Clear / 12.24
0932	3.9	9.38	0.760	13.3	16.39	14.48	106.9	Clear / 12.24
0935	4.1	9.35	0.765	14.6	16.16	14.46	110.9	Clear / 12.24
0938	4.2	9.32	0.767	12.1	15.82	14.46	114.2	clear / 12.24
0941	4.3	9.28	0.766	14.4	15.56	14.56	118.8	Clear / 12.23
0944	4.5	9.24	0.765	15.2	15.41	14.55	122.6	clear / 12.23
0947	4.6	9.20	0.760	15.5	14.81	14.57	127.1	Clear / 12.22
0950	4.7	9.16	0.758	15.5	14.56	14.65	129.9	clear / 12.20
0953	4.8	9.12	0.752	15.4	14.72	14.62	132.6	Clear / 12.18

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0957	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	0957	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	0957	(2) 0.5 L Amber Glass	cool to 4°C	

End Time

1008

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

flow rate 200mL/min

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station  
Sample: ID  
Field Conditions

PL2-605AR  
Date 4/29/10  
Field Team: (Initials) JB WM  
cloudy, cool → sunny, cool

## Purge Information

Well Diameter (in.)  
Well Depth (ft.)  
Initial Depth to Water (ft.)  
Depth of Water Column  
3 Casing Volumes  
1 Casing Volume

2  
22.0  
10.34  
11.66  
5.60  
1.87

(10.22 on 4/29/10)

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other :

Start Time

End Time

Total Gallons Purged

1009  
1157  
4.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance / DTW (ft)
1009	0							orange / 10.22
1103	2.4	7.76	2.193	31.7	0.88	14.63	-19.4	slight orange / 10.32
1108	2.6	7.55	2.191	26.1	0.69	14.37	-32.4	clearing / 10.34
1113	2.8	7.41	2.171	21.5	0.61	14.66	-41.7	clearing / 10.35
1118	3.0	7.35	2.170	19.2	0.54	14.40	-49.8	clearing / 10.35
1123	3.2	7.29	2.153	13.7	0.52	14.61	-56.6	clearing / 10.36
1126	3.3	7.29	2.137	13.5	0.50	14.81	-60.2	clearing / 10.36
1129	3.5	7.20	2.118	13.0	0.49	14.99	-64.5	clear / 10.37
1132	3.6	7.47	2.103	11.2	0.50	15.04	-68.2	clear / 10.37
1135	3.7	7.53	2.106	11.7	0.51	15.05	-71.0	clear / 10.38
1138	3.9	7.54	2.115	10.6	0.52	15.02	-73.6	clear / 10.38
1141	4.1	7.50	2.103	9.81	0.54	15.00	-75.4	clear / 10.38

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1144	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1144	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1144	(2) 0.5 L Amber Glass	cool to 4°C	

End Time

1157

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

ARI Assigned Number:	Turn-around Requested: <i>Standard</i>
----------------------	-------------------------------------------

ARI Client Company: Baeing Phone: \_\_\_\_\_

Client Contact: Will Ernst

Client Project Name: OA-9 IM Performance Sampling

Client Project #:	Samplers:
175122 OA-9	J. Bernthal + M. Mogg

Sample ID	Date	Time	Matrix	No. Containers
-----------	------	------	--------	----------------

GW-100427-PLZ-332A-0	4/27/10	0937	GW	8
----------------------	---------	------	----	---

GL-100427-PL2-604A-Ø	4/27/00	1049	GL	24
----------------------	---------	------	----	----

GW-180427-PLZ-310A-0	4/27/18	1159	GW	8
----------------------	---------	------	----	---

GW-1004279L2-31A-0	4/27/04	1349	GLW	8
GW-1004279L2-31A-1	4/27/04	1355	GLW	8

GW-10042742-314	4/27/10	1555	GW	0
T-01	4/27/10		GW	?

Trip Blank	11/11/17	1	1	1

--	--	--	--	--

--	--	--	--	--

Comments/Special Instructions	Relinquished by:			Received by:

Comments/Special Instructions	
(Signature)	(Signature)
Printed Name:	Printed Name:

Company:	Josh Beardsley	Company:	A-1
----------	----------------	----------	-----

Date & Time:	EPI	Date & Time:
--------------	-----	--------------

	4/27/10	15-00	4/27
--	---------	-------	------

Page: of

Date: 4/27/10	Ice Present? Y
------------------	-------------------

No. of Coolers:	1	Cooler Temps:	4.6
-----------------	---	---------------	-----



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants  
4611 South 134th Place, Suite 100  
Tukwila, WA 98168  
206-695-6200 206-695-6201 (fax)

Analysis Requested	Notes/Comments
--------------------	----------------

[illegible][illegible][illegible]

X	X	X						

x	x	x						MS/MSD

4	X	X							
5	X	X							

X	X	X						
X	X	X						

$\alpha$	$\chi$				$\frac{1}{3}$			
----------	--------	--	--	--	---------------	--	--	--

[illegible][illegible]


[illegible]

	(Signature)	(Signature)
	Printed Name:	Printed Name:

Volgard Sun		
31	Company:	Company:

60-1506	Date & Time:	Date & Time:
---------	--------------	--------------

methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.



# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: <i>Standard</i>	Page: <i>1</i> of <i>1</i>
ARI Client Company: <i>Bosco</i>	Phone:	Date: <i>4/29/10</i> Ice Present?
Client Contact: <i>Will Ernst</i>	No. of Coolers:	Cooler Temps:



Analytical Resources, Incorporated  
Analytical Chemists and Consultants  
4611 South 134th Place, Suite 100  
Tukwila, WA 98168  
206-695-6200 206-695-6201 (fax)

Client Project Name: <i>OA-9 IM Performance Sampling</i>					Analysis Requested								Notes/Comments	
Client Project #: <i>17512.2</i>		Samplers: <i>J. Bernthal &amp; M. Mogg</i>			EPA 8260C	VOCs	TPH-GX	TPH-DX						
Sample ID	Date	Time	Matrix	No. Containers										
<i>GW-100429-PL2-606A-0</i>	<i>4/29/10</i>	<i>0957</i>	<i>GW</i>	<i>8</i>	<i>X</i>	<i>X</i>	<i>X</i>							
<i>GW-100429-PL2-605AR-0</i>	<i>4/29/10</i>	<i>1144</i>	<i>GW</i>	<i>8</i>	<i>X</i>	<i>X</i>	<i>X</i>							
<i>Trip Blank</i>	<i>4/29/10</i>	<i>—</i>	<i>GW</i>	<i>2</i>	<i>X</i>	<i>X</i>								
Comments/Special Instructions	Relinquished by: (Signature) <i>[Signature]</i>		Received by: (Signature) <i>[Signature]</i>		Relinquished by: (Signature)				Received by: (Signature)					
	Printed Name: <i>Monica Mogg</i>		Printed Name: <i>Alka Muluumba</i>		Printed Name:				Printed Name:					
	Company: <i>EPI</i>		Company: <i>ARI</i>		Company:				Company:					
	Date & Time: <i>4/29/10 1340</i>		Date & Time: <i>4/29/10 1340</i>		Date & Time:				Date & Time:					

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, notwithstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.



**ATTACHMENT E**  
**DATA VALIDATION REPORTS**



## TECHNICAL MEMORANDUM

**Date:** March 11, 2010  
**To:** Will Ernst  
**From:** Jill Lamberts, Staff Environmental Scientist  
Kent Angelos, Principal and Project Director  
**cc:** Doug Kunkel, and Jeff Dengler, EPI  
**Email:** jill\_lamberts@golder.com  
**RE: BOEING PLANT 2 – OA 9 IM DATA VALIDATION REVIEW – JAN 2010 SAMPLING ROUND**

### 1.0 INTRODUCTION

A total of 8 water samples (including 1 field duplicate and 1 trip blank) were collected January 29, 2010 as part of the Boeing Plant 2 Groundwater Interim Measures Work Plan for Other Area 09 (OA 09) (July, 2008). These samples are for the Quarterly Sampling Program. Samples were analyzed by Analytical Resources Incorporated (ARI) of Tukwila, Washington for the following parameters:

- Volatile Organic Compounds (VOCs) by EPA Method 8260C
- Total petroleum hydrocarbons – gas, diesel and diesel extended range by Washington State Method NWTPH-G and NWTPH-Dx

Samples were analyzed in accordance with procedures described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA SW-846, 3rd edition)* and *Washington State Department of Ecology*.

### 2.0 SAMPLE DELIVERY GROUPS, SAMPLES AND ANALYSES

Samples were analyzed and results reported by the laboratory in batch numbers as summarized below:

#### QH61 (VOCs, NWTPH-G, NWTPH-Dx):

GW-100128-PL2-332A-0	GW-100128-PL2-311A-1	GW-100128-PL2-311A-0
GW-100128-PL2-604A-0	GW-100128-PL2-605AR-0	Trip Blank
GW-100128-PL2-310A-0	GW-100128-PL2-606A-0	

Quality assurance/quality control (QA/QC) reviews of laboratory data were performed in the laboratory in accordance with the laboratory quality assurance program plan. The data validation QA/QC review focused primarily on laboratory result summary sheets and quality control summary sheets to ensure that work plan data quality objectives were met for the project.

Data validation was conducted in accordance with the criteria outlined in the National Functional Guidelines for Organic Data Review (EPA 2008) modified to include method-specific requirements of the laboratory analytical methods. Raw data sheets were reviewed as necessary to confirm conditions reported and to support application of qualifiers to analytical results.

The validation level for the data is Level 1, as described in the QAPP (EPI, 2008). The following is a summary of quality control elements associated with each analytical fraction and the status of that element as a result of the data validation process.

### 3.0 SAMPLING, DOCUMENTATION AND REPORTING

Sample acknowledgements, chain-of-custody, request forms and data package completeness were evaluated with the following noted:

bp2 oa 9 im perf 05 dv report - 031110 - final

Golder Associates Inc.  
18300 NE Union Hill Road, Suite 200  
Redmond, WA 98052 USA  
Tel: (425) 883-0777 Fax: (425) 882-5498 www.golder.com

Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

- SDG QH61: Cooler receipt form indicates that the sample date on the chain of custody was 1/28/2010, but the sample labels had a date of 1/29/2010. The lab was able to determine that the sample date was 1/29/2010 based on the sampling time having the same time as a field duplicate sample.
- Results for volatile organic compound 1, 1, 2-trichloro-1, 2, 2-trifluoroethane are reported in a truncated format (1, 1, 2-trichloro-1, 2, 2-trifluoroe) due to ARI report format. No action was taken.

## 4.0 VOLATILE ORGANIC COMPOUNDS

Level 1 summary data packages were provided for the VOC analysis. The items reviewed during validation are summarized below.

### 4.1 Analytical Methods – acceptable

Samples for VOC analysis were analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA SW846 Method 8260C. The QAPP lists the method for VOCs as 8260B. ARI recently updated their methods due to a NELAP audit and a memo dated 6/1/2009 was sent to Boeing, EPI, and Golder Project Managers informing them of the change.

### 4.2 Sample Holding Times and Preservations – acceptable

All samples were prepared and analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples) with the following exceptions:

- SDG QH61: Cooler receipt form indicates that the VOC vials for sample GW-100128-PL2-604A-0 had one pea-sized bubble in one of the vials. No action was required since the samples were all analyzed within 7 days and the other vial was ok.
- SDG QH61: The case narrative that the Trip Blank was received with a pH of 4. No action was taken as the sample was analyzed in less than 7 days.

### 4.3 Laboratory Reporting Limits

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008) with the following exceptions:

- Quality assurance project plan (QAPP) reporting limits were not met for nine compounds. A review of current ARI detection limits shows that both method and reporting limits were recently updated (as of 6/1/2009). Compounds that do not meet QAPP stipulated reporting levels (RLs) are identified in the following table:

**TABLE 1**  
**OA12 Reporting Limits**

Compound	QAPP Table 5 RLs (µg/L)	Lab Reported RLs (µg/L)
Chloromethane	0.2	0.5
Bromomethane	0.2	0.5
Methylene Chloride	0.3	0.5
Acetone	3	5.0
2-Butanone	2	5.0
Vinyl Acetate	0.5	1.0
2-Chloroethylvinylether	0.5	1.0
4-Methyl-2-Pentanone	2	5.0
2-Hexanone	2	5.0

- No action was taken; this change in the RLs was sent by ARI to Boeing, EPI, and Golder Project Managers on June 1, 2009 and subsequently approved and implemented as part of the June 2009 QAPP compendium (Golder, 2009).
- Trichloroethene is listed twice in QAPP Table 5. No action was taken.
- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds.

#### 4.4 Instrument Calibration

Calibration review is not required under the QAPP; however, the lab provided information on the calibration performance in the case narratives. All of the calibration criteria were met with the following exceptions:

- SDG QH61: ARI reported that the ccal for Acetone was out of control low on the 2/2/2010 date of analysis. Associated samples were qualified as estimated (J/UJ).

#### 4.5 Blank Contamination – acceptable

The method blanks and trip blanks were free of contamination

#### 4.6 Surrogate Recovery – acceptable

All surrogate recoveries were within control.

#### 4.7 Matrix Spike Compound Recovery – acceptable

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-100128-PL2-604A-0 in SDG QH61. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable with the following comments:

- SDG PI20: The MS percent recovery was out of control low for 2-Chloroethylvinylether and the MSD percent recovery was out of control for styrene. No further action was taken as the LCS/LCSD and MS or MSD recoveries were in control.

Refer to Laboratory Control Sample data and field duplicate data for additional precision and accuracy information.

#### 4.8 Laboratory Control Sample Recovery – acceptable

Laboratory control samples (LCS) were evaluated using control limits listed in Table 4 of the QAPP (EPI, 2008) and recently updated CLs on the ARI website. All LCS/LSCD recoveries and relative percent differences (RPDs) were acceptable.

#### 4.9 Field Duplicate Sample Analysis – acceptable

Field duplicate samples were collected and analyzed as follows:

**TABLE 2**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
QH61	GW-100129-PL2-311A-0	GW-100129-PL2-311A-1

Field duplicate analysis criteria were met.

## 5.0 TOTAL PETROLEUM HYDROCARBON – GASOLINE, DIESEL, & MOTOR OIL

The laboratory provided a full data package for northwest total petroleum hydrocarbon (NWTPH) analysis for gasoline, diesel and motor oil; the items reviewed during validation are summarized below.

### 5.1 Analytical Methods – *acceptable*

Samples for TPH parameters were analyzed using the following methodology:

- NWTPH–Gasoline in the Toluene–Naphthalene range;
- NWTPH–Diesel in the C12–C24 range; and
- TPH–Motor Oil in the C24–C38 range.

### 5.2 Sample Holding Times – *acceptable*

All samples were prepared and/or analyzed within the recommended holding times:

- NWTPH-G – All samples were analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples).
- NWTPH-Dx – All samples were extracted within 7 days for waters of sample collection and analyzed within 40 days from collection to analysis.

### 5.3 Laboratory Reporting

The laboratory compared sample chromatograms with gas, diesel and motor oil standard chromatograms and based on this comparison ARI qualified these results (as GRO, DRO, or MMO) to indicate qualitative or quantitative uncertainty with the results (the chromatogram was a poor match or other organics were detected in the sample). NWTPH-G and/or NWTPH-Dx (diesel and motor oil) sample results are considered estimated and qualified 'J' in the following instances.

- SDG QH61: Samples GW-100128-PL2-604A-0, GW-100128-PL2-310A-0, GW-100128-PL2-605AR-0, GW-100129-PL2-311A-0, and GW-100129-PL2-311A-1 for NWTPH-G were qualified with a GRO qualifier. Results are qualified as estimated (J).

### 5.4 Laboratory Reporting Limits – *acceptable*

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008). The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds. No action was taken.

### 5.5 Blank Contamination – *acceptable*

The method and equipment blanks were free of target compounds.

### 5.6 Surrogate Recovery – *acceptable*

All surrogate recoveries were within control limits.

### 5.7 Matrix Spike Compound Recovery

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-100128-PL2-604A-0 in SDG QH61. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable with the following exceptions:

- SDG QH61: The MS/MSD for NWTPH-G was out of control for sample GW-100128-PL2-604A-0. The sample was qualified as estimated due to matrix effects (J).

## 5.8 Laboratory Control Sample Recovery – acceptable

Laboratory control samples (LCS) were evaluated and were within the control limits listed in the QAPP (EPI, 2008).

## 5.9 Field Duplicate Sample Analysis – acceptable

Field duplicate samples were collected and analyzed as follows:

**TABLE 3**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
QH61	GW-100129-PL2-311A-0	GW-100129-PL2-311A-1

Field duplicate analysis criteria were met.

## 6.0 DATA QUALIFIERS


Data qualifiers applied by the laboratory have been removed from the data summary report sheets and superseded by data validation qualifiers as follows:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

- U – The constituent was analyzed for, but was not detected above the reported sample quantitation limit.
- J – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result is less than the quantitation limit or quality control criteria were not met.
- J+ – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased high.
- J- – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased low.
- UJ – The constituent was not detected; the associated quantitation limit is an estimated value because quality control criteria were not met.
- R – Data are rejected due to significant exceedance of quality control criteria. The analyte may or may not be present. Additional sampling and analysis may be required to determine the presence or absence of the constituent. For statistical reasons, rejected values are not included in the database.
- UR – The constituent is rejected at the reported quantitation limit.
- Y – The reporting limit is elevated due to interference. The result is not detected.

## 7.0 DATA ASSESSMENT

Data review and validation was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project. This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional judgment, the data are acceptable for use except where indicated by data qualifiers, which may modify the usefulness of those individual values.

  
\_\_\_\_\_  
Jill Lamberts  
Staff Environmental Scientist, Golder

\_\_\_\_\_  
March 11, 2010  
Date

  
\_\_\_\_\_  
Kent Angelos  
Principal & Project Director, Golder

\_\_\_\_\_  
March 22, 2010  
Date

## 8.0 REFERENCES

EPA 2008, USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, EPA-540-R-08-01, June, 2008.

EPI 2008, Interim Measures Work Plan For Other Area 9, Boeing Plant 2, Seattle/Tukwila, Washington, Prepared by Environmental Partners, Inc. (EPI), July 2008 (Includes QAPP).

Golder Associates Inc. (Golder), 2009, Compendium of Sampling and Analysis Plans and Quality Assurance Plans for Boeing Plant 2, Prepared for The Boeing Company by Golder Associates Inc. (Golder) and Environmental Partners, Inc. (EPI), June of 2009.



## TECHNICAL MEMORANDUM

**Date:** May 20, 2010  
**To:** Will Ernst  
**From:** Kate McPeck, Environmental Scientist  
Kent Angelos, Principal and Project Director  
**cc:** Doug Kunkel, and Jeff Dengler, EPI  
**RE:** **BOEING PLANT 2 – OA 9 IM DATA VALIDATION REVIEW – APRIL 2010 SAMPLING ROUND**

---

### 1.0 INTRODUCTION

A total of 9 water samples (including 1 field duplicate and 2 trip blanks) were collected April 27 and 29, 2010 as part of the Boeing Plant 2 Groundwater Interim Measures Work Plan for Other Area 09 (OA 09) (July, 2008). These samples are for the Quarterly Sampling Program. Samples were analyzed by Analytical Resources Incorporated (ARI) of Tukwila, Washington for the following parameters:

- Volatile Organic Compounds (VOCs) by EPA Method 8260C
- Total petroleum hydrocarbons – gas, diesel and diesel extended range by Washington State Method NWTPH-G and NWTPH-Dx

Samples were analyzed in accordance with procedures described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA SW-846, 3rd edition)* and *Washington State Department of Ecology*.

### 2.0 SAMPLE DELIVERY GROUPS, SAMPLES AND ANALYSES

Samples were analyzed and results reported by the laboratory in batch numbers as summarized below:

**QU47 (VOCs, NWTPH-G, NWTPH-Dx):**

GW-100427-PL2-332A-0	GW-100427-PL2-310A-0	GW-100427-PL2-311A-1
GW-100427-PL2-604A-0	GW-100427-PL2-311A-0	Trip Blank

**QU68 (VOCs, NWTPH-G, NWTPH-Dx):**

GW-100429-PL2-606A-0	GW-100429-PL2-605AR-0	Trip Blank
----------------------	-----------------------	------------

Quality assurance/quality control (QA/QC) reviews of laboratory data were performed in the laboratory in accordance with the laboratory quality assurance program plan. The data validation QA/QC review focused primarily on laboratory result summary sheets and quality control summary sheets to ensure that work plan data quality objectives were met for the project.

Data validation was conducted in accordance with the criteria outlined in the National Functional Guidelines for Organic Data Review (EPA 2008) modified to include method-specific requirements of the laboratory analytical methods. Raw data sheets were reviewed as necessary to confirm conditions reported and to support application of qualifiers to analytical results.

The validation level for the data is Level 1, as described in the QAPP (EPI, 2008). The following is a summary of quality control elements associated with each analytical fraction and the status of that element as a result of the data validation process.



### 3.0 SAMPLING, DOCUMENTATION AND REPORTING

Sample acknowledgements, chain-of-custody, request forms and data package completeness were evaluated with the following noted:

- Results for volatile organic compound 1, 1, 2-trichloro-1, 2, 2-trifluoroethane are reported in a truncated format (1, 1, 2-trichloro-1, 2, 2-trifluoroe) due to ARI report format. No action was taken.

### 4.0 VOLATILE ORGANIC COMPOUNDS

Level 1 summary data packages were provided for the VOC analysis. The items reviewed during validation are summarized below.

#### 4.1 Analytical Methods – *acceptable*

Samples for VOC analysis were analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA SW846 Method 8260C. The QAPP lists the method for VOCs as 8260B. ARI recently updated their methods due to a NELAP audit and a memo dated 6/1/2009 was sent to Boeing, EPI, and Golder Project Managers informing them of the change.

#### 4.2 Sample Holding Times and Preservations – *acceptable*

All samples were prepared and analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples) with the following exceptions:

- SDG QU47: Cooler receipt form indicates that the VOC vials for the trip blank had two small air bubbles. No action was required since the samples were analyzed within 7 days.

#### 4.3 Laboratory Reporting Limits

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008) with the following exceptions:

- Quality assurance project plan (QAPP) reporting limits were not met for nine compounds. A review of current ARI detection limits shows that both method and reporting limits were recently updated (as of 6/1/2009). Compounds that do not meet QAPP stipulated reporting levels (RLs) are identified in the following table:

**TABLE 1**  
**OA12 Reporting Limits**

Compound	QAPP Table 5 RLs (µg/L)	Lab Reported RLs (µg/L)
Chloromethane	0.2	0.5
Bromomethane	0.2	0.5
Methylene Chloride	0.3	0.5
Acetone	3	5.0
2-Butanone	2	5.0
Vinyl Acetate	0.5	1.0
2-Chloroethylvinylether	0.5	1.0
4-Methyl-2-Pentanone	2	5.0
2-Hexanone	2	5.0

- No action was taken; this change in the RLs was sent by ARI to Boeing, EPI, and Golder Project Managers on June 1, 2009 and subsequently approved and implemented as part of the June 2009 QAPP compendium (Golder, 2009).
- Trichloroethene is listed twice in QAPP Table 5. No action was taken.
- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds.

#### 4.4 Instrument Calibration – *acceptable*

Calibration review is not required under the QAPP; however, the lab provided information on the calibration performance in the case narratives. All of the calibration criteria were met.

#### 4.5 Blank Contamination – *acceptable*

The method blanks and trip blanks were free of contamination

#### 4.6 Surrogate Recovery

All surrogate recoveries were within control with the following exception:

- SDG QU47: Surrogate DCE was out of control high for sample GW-100427-PL2-310A-0. The sample was reanalyzed with the surrogate recovery in control. Detects for the initial analysis of this sample were qualified as estimated (J).

#### 4.7 Matrix Spike Compound Recovery

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-100427-PL2-604A-0 in SDG QU47. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable with the following exceptions:

- SDG QU47: The MS and MSD percent recoveries were out of control low for 2-Chloroethylvinylether and the out of control high for vinyl acetate. The parent sample was qualified UR for 2-chloroethylvinylether. Vinyl acetate was not detected in the sample; therefore no action was taken.

Refer to Laboratory Control Sample data and field duplicate data for additional precision and accuracy information.

#### 4.8 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated using control limits listed in Table 4 of the QAPP (EPI, 2008) and recently updated CLs on the ARI website. All LCS/LSCD recoveries and relative percent differences (RPDs) were acceptable.

#### 4.9 Field Duplicate Sample Analysis

Field duplicate samples were collected and analyzed as follows:

**TABLE 2**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
QU47	GW-100427-PL2-311A-0	GW-100427-PL2-311A-1

Field duplicate analysis criteria were met with the following exception:

- RPD for ethylbenzene was 22%. No action was taken except to note.

## 5.0 TOTAL PETROLEUM HYDROCARBON – GASOLINE, DIESEL, & MOTOR OIL

The laboratory provided Level I summary data packages for northwest total petroleum hydrocarbon (NWTPH) analysis for gasoline, diesel and motor oil. Items reviewed during validation are summarized below.

### 5.1 Analytical Methods – *acceptable*

Samples for TPH parameters were analyzed using the following methodology:

- NWTPH–Gasoline in the Toluene–Naphthalene range;
- NWTPH–Diesel in the C12–C24 range; and
- TPH–Motor Oil in the C24–C38 range.

### 5.2 Sample Holding Times – *acceptable*

All samples were prepared and/or analyzed within the recommended holding times:

- NWTPH-G – All samples were analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples).
- NWTPH-Dx – All samples were extracted within 7 days for waters of sample collection and analyzed within 40 days from collection to analysis.

### 5.3 Laboratory Reporting – *acceptable*

The laboratory compared sample chromatograms with gas, diesel and motor oil standard chromatograms. Based on this comparison ARI qualifies (GRO, DRO, or MMO) when necessary to indicate qualitative or quantitative uncertainty with the results (the chromatogram was a poor match or other organics were detected in the sample). NWTPH-G and/or NWTPH-Dx (diesel and motor oil) sample results for SDGs QU47 and QU68 were not qualified.

### 5.4 Laboratory Reporting Limits – *acceptable*

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008). The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds. No action was taken.

### 5.5 Blank Contamination – *acceptable*

The method and equipment blanks were free of target compounds.

### 5.6 Surrogate Recovery – *acceptable*

All surrogate recoveries were within control limits.

### 5.7 Matrix Spike Compound Recovery

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-100427-PL2-604A-0 in SDG QU47 for NWTPH-G. Due an analyst error, the MS and MSD were not analyzed diesel and motor oil. No action was taken except to note this. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable.

## 5.8 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated and were within the control limits listed in the QAPP (EPI, 2008).

## 5.9 Field Duplicate Sample Analysis – *acceptable*

Field duplicate samples were collected and analyzed as follows:

**TABLE 3**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
QU47	GW-100427-PL2-311A-0	GW-100427-PL2-311A-1

Field duplicate analysis criteria were met.

## 6.0 DATA QUALIFIERS

Data qualifiers applied by the laboratory have been removed from the data summary report sheets and superseded by data validation qualifiers as follows:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

- U – The constituent was analyzed for, but was not detected above the reported sample quantitation limit.
- J – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result is less than the quantitation limit or quality control criteria were not met.
- J+ – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased high.
- J- – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased low.
- UJ – The constituent was not detected; the associated quantitation limit is an estimated value because quality control criteria were not met.
- R – Data are rejected due to significant exceedance of quality control criteria. The analyte may or may not be present. Additional sampling and analysis may be required to determine the presence or absence of the constituent. For statistical reasons, rejected values are not included in the database.
- UR – The constituent is rejected at the reported quantitation limit.
- Y – The reporting limit is elevated due to interference. The result is not detected.

## 7.0 DATA ASSESSMENT

Data review and validation was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project. This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional judgment, the data are acceptable for use except where indicated by data qualifiers, which may modify the usefulness of those individual values.



Kate McPeck  
Environmental Scientist, Golder

May 20, 2010

Date



Kent Angelos  
Principal & Project Director, Golder

May 20, 2010

Date

## 8.0 REFERENCES

EPA 2008, USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, EPA-540-R-08-01, June, 2008.

EPI 2008, Interim Measures Work Plan For Other Area 9, Boeing Plant 2, Seattle/Tukwila, Washington, Prepared by Environmental Partners, Inc. (EPI), July 2008 (Includes QAPP).

Golder Associates Inc. (Golder), 2009, Compendium of Sampling and Analysis Plans and Quality Assurance Plans for Boeing Plant 2, Prepared for The Boeing Company by Golder Associates Inc. (Golder) and Environmental Partners, Inc. (EPI), June of 2009.